East Fork Little Sandy Stream Restoration Project Lawrence County, Kentucky

Sections 404/401 Clean Water Act (CWA) Permit Application

Prepared for:

Kentucky Department of Fish and Wildlife Resources

March 2009

EAST FORK LITTLE SANDY
STREAM RESTORATION PROJECT
LAWRENCE COUNTY, KENTUCKY

SECTIONS 404/401 CLEAN WATER ACT (CWA) PERMIT APPLICATION OUTLINE

I. Section 404 Nationwide Permit Application and Attachments

1. Permit Application
2. Block 22 Attachment
3. Block 24 Attachment

II. Section 401 Water Quality Certification Application

1. Water Quality Certification Application

III. Jurisdictional Determination Forms

1. Overview Table of Jurisdictional Waters
2. Preliminary Jurisdictional Determination Forms
3. Jurisdictional Waters of the United States Map

IV. Mitigation Plan

1. Mitigation Plan Report
2. Appendices

V. Agency Correspondence

1. State Historic Preservation Officer
2. Department of the Interior

I. Section 404 Nationwide Permit Application and Attachments

1. Permit Application

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT *(33 CFR 325)*

OMB APPROVAL NO. 0710-003

PRIVACY ACT STATEMENT

Authority: 33 USC 401, Section 10: 1413, Section 404. Principal Purpose: These laws require authorizing activities in or affecting, navigable waters of the United States, the discharge or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application for a permit. Disclosure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME Kentucky Department of Fish and Wildlife Resources Benjamin Kinman	8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required) Stantec Consulting Services, Inc. Stephen D. Hall, Senior Associate
6. APPLICANT'S ADDRESS Kentucky Department of Fish and Wildlife Resources #1 Sportsman's Lane Frankfort, KY 40601	9. AGENT'S ADDRESS Stantec Consulting Services, Inc. 350 Missouri Ave Suite 100 Jeffersonville, IN 47130
7. APPLICANT'S PHONE NOs. W/AREA CODE a. Residence b. Business (502) 564-3400 ext: 4466	10. AGENT'S PHONE NOs. W/AREA CODE a. Residence b. Business (812) 285-4060

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Stephen D. Hall, Stantec Consulting Services, Inc. to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

APPLICANT'S SIGNATURE _____ DATE _____

NAME, LOCATION, AND DESCRIPTION OR PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

East Fork Little Sandy Stream Restoration Project

13. NAME OF WATERBODY, IF KNOWN (if applicable)

East Fork Little Sandy River and Little East Fork

14. PROJECT STREET ADDRESS (if applicable)

Sunset Ranch, 800 Hwy 1796 Louisa, KY 41230

15. LOCATION OF PROJECT

Lawrence	Kentucky
COUNTY	STATE

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions) **Section, Township, Range, Lat/Lon, and/or Accessors's Parcel Number, for example.**

USGS Fallsburg, KY Quad (38 ˚ 13'05" N, 82˚44'25" W)

17. DIRECTIONS TO THE SITE –

From Louisville, take I-64 East to Exit 172, go south on Route 7 into Grayson; At Grayson, go south on Route 1 for approximately 9.5 miles to Willard; after Willard, turn left onto Route 1496; Travel approximately 8.7 miles on Route 1496 to the site. The majority of the project is located on Sunset Ranch.

18. Nature of Activity (Description of project, include all features)

The proposed activity consists of the restoration and enhancement of approximately 12,757 linear feet (LF) of East Fork Little Sandy River and related tributaries. This includes the relocation of 9,511 LF of stream to increase sinuosity and decrease erosion potential. Restoration activities include: the creation of a floodplain by benching along one or both sides of the channel; reshaping of the existing channel; installation of in-stream structures that will allow for aquatic habitat, as well as provide erosion and grade control; and the planting of riparian vegetation to provide stability along the banks.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Utilizing in-lieu fee funds, distributed by the KY Department of Fish and Wildlife Resources, this project will result in the restoration of the function and value of streams within the East Fork Little Sandy River project area.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

To ultimately enhance the stream, fill will need to be discharged into sections of East Fork Little Sandy River and Little East Fork where portions are being relocated in the design.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards

Approximately 25,000 cubic yards of native rock and soil will be placed within the existing East Fork Little Sandy River, Little East Fork, and related tributaries channels. The native rock and soil that will place in the existing channels will be moved from relocation areas within the project area.

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

There are no wetlands impacts in the project.
Approximately 5.51 acres of stream will be impacted in this project.

23. Is Any Portion of the Work Already Complete? Yes __ No X IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

See Attachment Block 24

25. List of Other Certifications or Approvals/Denials Received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
KY Div. of Water	401 WQC			Pending Approval	
KY Div. of Water	Floodplain			Pending Approval	

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT	DATE	SIGNATURE OF AGENT	DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

2. Block 22 Attachment

BLOCK 22 ATTACHMENT

SUMMARY OF SECTION 404 RELOCATED STREAM LENGTHS

East Fork Little Sandy Stream Restoration Project
Lawrence County, Kentucky

Affected Stream	Watershed Area (Sq. Mi.)	Flow Regime	Affected Length (Ft.)	Area of Waters Affected (Ac.)
East Fork Little Sandy Reach 1	7.59	Perennial	4,165	3.01
Little East Fork Reach 1	2.16	Perennial	1,627	0.68
Little East Fork Tributary	0.067	Intermittent	280	0.04
Tributary 1 Reach 1	0.152	Intermittent	590	0.09
Tributary 1 Reach 2	0.219	Intermittent	1,770	0.35
Tributary 1 Reach 3	0.306	Intermittent	661	0.15
Tributary 1A	0.025	Ephemeral	108	0.01
Tributary 2 Reach 2	0.025	Intermittent	310	0.05
Total			**9,511**	**4.38**

3. Block 24 Attachment

BLOCK 24 ATTACHMENT

ADDRESSES OF ADJOINING PROPERTY OWNERS

East Fork Little Sandy Stream Restoration Project
Lawrence County, Kentucky

Jack Holcomb
Sunset Ranch
800 Hwy 1496
Louisa, KY 41230
606-686-1100

Elmer Lucas
Route 1 Box 129
Salt Rock, WV 25559
304-736-9707

Bill Morehead
PO Box 322
Louisa, KY 41230
606-686-9267

James Metz
513 Little East Fork Rd
Louisa, KY 41230
606-686-2793

Carl Kirk
345 Little East Fork Rd
Louisa, KY 41230
606-686-3369

II. Section 401 Water Quality Certification Application

1. Water Quality Certification Application

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES & ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRNOMENTAL PROTECTION
DIVISION OF WATER

APPLICATION FOR PERMIT TO CONSTRUCT ACROSS OR ALONG A STREAM AND / OR WATER QUALITY CERTIFICATION

Chapter 151 of the Kentucky Revised Statutes requires approval from the Division of Water prior to any construction or other activity in or along a stream that could in any way obstruct flood flows or adversely impact water quality. *If the project involves work in a stream, such as bank stabilization, dredging or relocation, you will also need to obtain a 401 Water Quality Certification (WQC) from the Division of Water.* This completed form will be forwarded to the Water Quality Branch for WQC processing. The project may not start until all necessary approvals are received from the KDOW. For questions concerning the WQC process, contact WQC at 502/564-3410.

If the project will disturb more than 1 acre of soil, you will also need to complete the attached Notice of Intent for Storm Water Discharges, and return both forms to the Floodplain management Section of the KDOW. This general permit will require you to create an implement an erosion control plan for the project.

1. **OWNER:** Benjamin Kinman, Kentucky Department of Fish & Wildlife Resources
   Give name of person(s), company, governmental unit, or other owner of proposed project.
   MAILING ADDRESS: #1 Sportsman's Lane
   Frankfort, KY 40601
   TELEPHONE #: (502) 564-3400 ext: 4466 **EMAIL:** Benjamin.Kinman@ky.gov
2. **AGENT:** Stephen D. Hall, Stantec Consulting Services, Inc.
   Give name of person(s) submitting application, if other than owner.
   ADDRESS: 350 Missouri Ave, Ste. 100
   Jeffersonville, IN 47130
3. **ENGINEER:** Joseph Eigel, PE, PhD **P.E. NUMBER:** 14318
   Contact Division of Water if waiver can be granted.
   TELEPHONE #: (812) 285-4060 **EMAIL:** Joe.Eigel@stantec.com
4. **DESCRIPTION OF CONSTRUCTION:** The proposed activity consists of the restoration and enhancement of approximately 12,757 feet of East Fork Little Sandy River and tributaries. This includes the relocation of approximately 9,511 LF of stream to increase sinuosity and decrease erosion potential. Restoration activities include the creation of a floodplain by benching along one or both sides of the channel, reshaping of the existing channel, installation of in-stream structures that will enhance aquatic habitat, as well as provide erosion and grade control, and the planting of riparian vegetation to provide stability along the banks.
5. **COUNTY:** Lawrence **NEAREST COMMUNITY:** Louisa
6. **USGS QUAD NAME:** Fallsburg, KY **LATITUDE/LONGITUDE:** 38.0222˚ N, 82.9034˚ W
7. **STREAM NAME:** East Fork Little Sandy River
8. **LINEAR FEET OF STREAM IMPACTED:** 12,757 LF
9. **DIRECTIONS TO SITE**: From Louisville, take I-64 East to Exit 172; go south on Route 7 to Grayson. At Grayson, go south on Route 1 for approximately 9.5 miles to Willard. After Willard, turn left onto Route 1496. Travel approximately 8.7 miles on Route 1496 to the site. Most of the project is located on Sunset Ranch.
10. **IS ANY PORTION OF THE REQUESTED PROJECT NOW COMPLETE?** Yes **X** No If yes, identify the completed portion on the drawings you submit and indicate the date activity was completed. DATE: _____
11. **ESTIMATED BEGIN CONSTRUCTION DATE:** June 2009
12. **ESTIMATED END CONSTRUCTION DATE:** December 2009

13. **HAS A PERMIT BEEN RECEIVED FROM THE US ARMY, CORPS of ENGINEERS?** Yes X No If yes, attach a copy of that permit.

14. **THE APPLICANT *MUST* ADDRESS PUBLIC NOTICE:**

(a) PUBLIC NOTICE HAS BEEN GIVEN FOR THIS PROPOSAL BY THE FOLLOWING MEANS:

__X__ **Public notice in newspaper having greatest circulation in area (provide newspaper clipping or affidavit)**

_____ **Adjacent property owner(s) affidavits (Contact Division of Water for requirements.)**

(b) _____ I REQUEST WAIVER OF PUBLIC NOTICE BECAUSE:

15. **I HAVE CONTACTED THE FOLLOWING CITY OR COUNTY OFFICIALS CONCERNING THIS PROJECT:**

Tim S. Ellis, Local Floodplain Coordinator

Give name and title of person(s) contacted and provide copy of any approval city or county may have issued.

16. **LIST OF ATTACHMENTS: Location Map (Figure 1 – USGS Topo-map); Table 1 Summary of 401 Effected Stream Lengths; 404 Permit Application**

List plans, profiles, or other drawings and data submitted. Attach a copy of a 7.5 minute USGS topographic map clearly showing the project location.

17. **I, Benjamin Kinman (owner) CERTIFY THAT THE OWNER OWNS OR HAS EASEMENT RIGHTS ON ALL PROPERTY ON WHICH THIS PROJECT WILL BE LOCATED OR ON WHICH RELATED CONSTRUCTION WILL OCCUR (for dams, this includes the area that would be impounded during the design flood).**

18. **REMARKS:**

I hereby request approval for construction across or along a stream as described in this application and any accompanying documents. To the best of my knowledge, all the information provided is true and correct.

SIGNATURE: _____

Owner or Agent sign here. (If signed by Agent, a Power of Attorney should be attached.)

DATE: _____

SIGNATURE OF LOCAL FLOODPLAIN COORDINATOR:

_____

Permit application will be returned to applicant if not properly endorsed by the local floodplain coordinator.

DATE: _____

SUBMIT APPLICATION AND ATTACHMENTS TO:

Floodplain Management Section
Division of Water
200 Fair Oaks Lane. 4th Floor
Frankfort, KY 40601

III. Jurisdictional Determination Forms

1. Overview Table of Jurisdictional Waters

SUMMARY TABLE OF JURISDICTIONAL WATERS OF THE UNITED STATES

East Fork Little Sandy Stream Restoration Project
Lawrence County, Kentucky

Reach Number	Latitude	Longitude	Flow Regime	Existing Length in Project Area (LF)	Width of Channel (FT)	Area (acres)	Class of Aquatic Resource
EFLS	38.2219°N	82.7455°W	Perennial	5,000	31.5	3.62	non-section 10 – non-wetland
LEF-R1	38.2136°N	82.7470°W	Perennial	1,627	18.1	0.68	non-section 10 – non-wetland
LEF-R2	38.2157°N	82.7432°W	Perennial	1,491	13.1	0.45	non-section 10 – non-wetland
LEF Trib	38.2148°N	82.7466°W	Intermittent	280	5.5	0.04	non-section 10 – non-wetland
Trib1-R1	38.2296°N	82.7486°W	Intermittent	590	6.5	0.09	non-section 10 – non-wetland
Trib1-R2	38.2271°N	82.7476°W	Intermittent	1,770	8.5	0.35	non-section 10 – non-wetland
Trib1-R3	38.2243°N	82.7469°W	Intermittent	661	10.2	0.15	non-section 10 – non-wetland
Trib1A	38.2270°N	82.7470°W	Ephemeral	371	3.5	0.03	non-section 10 – non-wetland
Trib2-R1	38.2244°N	82.7507°W	Ephemeral	644	3.5	0.05	non-section 10 – non-wetland
Trib2-R2	38.2231°N	82.7500°W	Intermittent	310	6.5	0.05	non-section 10 – non-wetland
Reach Number	**Latitude**	**Longitude**	**Flow Regime**	**Length in Project Area (LF)**	**Width of Channel (FT)**	**Area (acres)**	**Class of Aquatic Resource**
WL 1	38.2151°N	82.7448°W	Wetland	-	-	0.78	Non-section 10 *
WL 2	38.2155°N	82.7438°W	Wetland	-	-	0.06	Non-section 10 *
TOTAL PERENNIAL				**8,118**	**-**	**4.75**	**-**
TOTAL INTERMITTENT				**3,611**	**-**	**0.68**	**-**
TOTAL EPHEMERAL				**1,015**	**-**	**0.08**	**-**
TOTAL WETLAND				**-**	**-**	**0.84**	**-**

*Wetlands within the site are not to be disturbed

2. Preliminary Jurisdictional Determination Forms

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 03/12/2009

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
Benjamin Kinman
Kentucky Department of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville District Office, East Fork Little Sandy Stream Restoration Project (Sunset Ranch), East Fork of the Little Sandy River, Little East Fork Tributary 1, Little East Fork Tributary 2

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The proposed activity consists of the restoration and enhancement of approximately 12,757 linear feet of East Fork Little Sandy River and tributaries. The project is located approximately 18 miles south of Grayson, KY off Route 1496.
(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State:KY County/parish/borough: Lawrence County City: Grayson
Center coordinates of site (lat/long in degree decimal format): Lat. 38.2219° N, Long. 82.7455° W.
Universal Transverse Mercator: 16
Name of nearest waterbody: Little Sandy River

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 8,118 linear feet: 20.9 average width (ft) and/or 4.75 acres.
Cowardin Class: Riverine
Stream Flow: Perennial
Wetlands: 0.84 acres. ***Wetlands are located along Little East Fork River and will not be disturbed.***
Cowardin Class: Emergent Scrub-shrub
Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: N/A
Non-Tidal: N/A

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 01/12/2009
☒ Field Determination. Date(s): 05/27/2008, 06/19/2008, 08/13/2008

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:Attached: Site Location Map, Jurisdictional Waters of the US Map.

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant. Attached: RBP data sheets

- ☐ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: .

☐ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

- ☐ USGS NHD data. ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name:1:24,000, Fallsburg Quad.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation:USDA and NRCS Soils Report for Lawrence and Martin Counties, KY. Survey on 12/18/2007.

☐ National wetlands inventory map(s). Cite name: .

☐ State/Local wetland inventory map(s): .

☒ FEMA/FIRM maps:FIS: Lawrence Co., KY Community # 210258. Revised: June 18, 1990.

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date):National Security Aerial Photography fsa_n19e_101 and fsa_n20e_101.
or ☒ Other (Name & Date):Attached: Photo Log (photos taken by Stantec on 05/27/2008, 06/19/2008, 08/13/2008.

☐ Previous determination(s). File no. and date of response letter: .

☐ Other information (please specify): .

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Signature and date of
Regulatory Project Manager
(REQUIRED)

Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining
the signature is impracticable)

SAMPLE

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
EFLS	38.2219°N	82.7455°W	Riverine	5000 linear feet/ 3.62 acre	Non-section 10 – non-wetland
LEF-R1	38.2136°N	82.7470°W	Riverine	1,627 linear feet/ 0.68 acre	Non-section 10 – non-wetland
LEF-R2	38.2157°N	82.7432°W	Riverine	1,491 linear feet/ 0.45 acre	Non-section 10 – non-wetland
WL 1*	38.2151°N	82.7448°W	Riverine	0.78 acre	Non-section 10 – wetland
WL 2*	38.2155°N	82.7438°W	Riverine	0.06 acre	Non-section 10 – wetland

*Wetlands within the site will not be disturbed.

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 03/12/2009

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
Benjamin Kinman
Kentucky Department of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville District Office, East Fork Little Sandy Stream Restoration Project (Sunset Ranch), Little East Fork Tributary, Tributary 1 Reach 1, Tributary 1 Reach 2, Tributary 1 Reach 3, Tributary 2 Reach 2

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The proposed activity consists of the restoration and enhancement of approximately 12,757 linear feet of East Fork Little Sandy River and tributaries. The project is located approximately 18 miles south of Grayson, KY off Route 1496.
(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State:KY County/parish/borough: Lawrence County City: Grayson
Center coordinates of site (lat/long in degree decimal format): Lat. 38.2219° N, Long. 82.7455° W.
Universal Transverse Mercator: 16
Name of nearest waterbody: Little Sandy River

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 3,611 linear feet: 7.4 average width (ft) and/or 0.68 acres.
Cowardin Class: Riverine
Stream Flow: Intermittent
Wetlands: N/A acres.
Cowardin Class: N/A
Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: N/A
Non-Tidal: N/A

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 01/12/2009
☒ Field Determination. Date(s): 05/27/2008, 06/19/2008, 08/13/2008

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:Attached: Site Location Map, Jurisdictional Waters of the US Map.

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant. Attached: RBP data sheets

- ☐ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: .

☐ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

- ☐ USGS NHD data. ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name:1:24,000, Fallsburg Quad.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation:USDA and NRCS Soils Report for Lawrence and Martin Counties, KY. Survey on 12/18/2007.

☐ National wetlands inventory map(s). Cite name: .

☐ State/Local wetland inventory map(s): .

☒ FEMA/FIRM maps:FIS: Lawrence Co., KY Community # 210258. Revised: June 18, 1990.

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date):National Security Aerial Photography fsa_n19e_101 and fsa_n20e_101.
or ☒ Other (Name & Date):Attached: Photo Log (photos taken by Stantec on 05/27/2008, 06/19/2008, 08/13/2008.

☐ Previous determination(s). File no. and date of response letter: .

☐ Other information (please specify): .

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Signature and date of Regulatory Project Manager (REQUIRED)

Signature and date of person requesting preliminary JD (REQUIRED, unless obtaining the signature is impracticable)

SAMPLE

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
LEF Trib	38.2148°N	82.7466°W	Riverine	280 linear feet/ 0.04 acre	Non-section 10 – non-wetland
Trib 1-R1	38.2296°N	82.7486°W	Riverine	590 linear feet/ 0.09 acre	Non-section 10 – non-wetland
Trib 1-R2	38.2271°N	82.7476°W	Riverine	1,770 linear feet/ 0.35 acre	Non-section 10 – non-wetland
Trib 1-R3	38.2243°N	82.7469°W	Riverine	661 linear feet/ 0.15 acre	Non-section 10 – non-wetland
Trib2-R2	38.2231°N	82.7500°W	Riverine	310 linear feet/ 0.05 acre	Non-section 10 – non-wetland

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 03/12/2009

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
Benjamin Kinman
Kentucky Department of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Louisville District Office, East Fork Little Sandy Stream Restoration Project (Sunset Ranch), Tributary 1A, Tributary 2 Reach 1

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The proposed activity consists of the restoration and enhancement of approximately 12,757 linear feet of East Fork Little Sandy River and tributaries. The project is located approximately 18 miles south of Grayson, KY off Route 1496.
(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State:KY County/parish/borough: Lawrence County City: Grayson
Center coordinates of site (lat/long in degree decimal format): Lat. 38.2270° N, Long. 82.7470° W.
Universal Transverse Mercator: 16
Name of nearest waterbody: Little Sandy River

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 1,015 linear feet: 3.5 width (ft) and/or 0.08 acres.
Cowardin Class: Riverine
Stream Flow: Ephemeral
Wetlands: N/A acres.
Cowardin Class: N/A

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal: N/A
Non-Tidal: N/A

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 01/12/2009
☒ Field Determination. Date(s): 05/27/2008, 06/19/2008, 08/13/2008

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:Attached: Site Location Map, Jurisdictional Waters of the US Map.

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant. Attached: RBP data sheets

- ☐ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: .

☐ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

- ☐ USGS NHD data. ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name:1:24,000, Fallsburg Quad.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation:USDA and NRCS Soils Report for Lawrence and Martin Counties, KY. Survey on 12/18/2007.

☐ National wetlands inventory map(s). Cite name: .

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☒ FEMA/FIRM maps:FIS: Lawrence Co., KY Community # 210258. Revised: June 18, 1990.

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date):National Security Aerial Photography fsa_n19e_101 and fsa_n20e_101.
or ☒ Other (Name & Date):Attached: Photo Log (photos taken by Stantec on 05/27/2008, 06/19/2008, 08/13/2008.

☐ Previous determination(s). File no. and date of response letter: .

☐ Other information (please specify): .

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

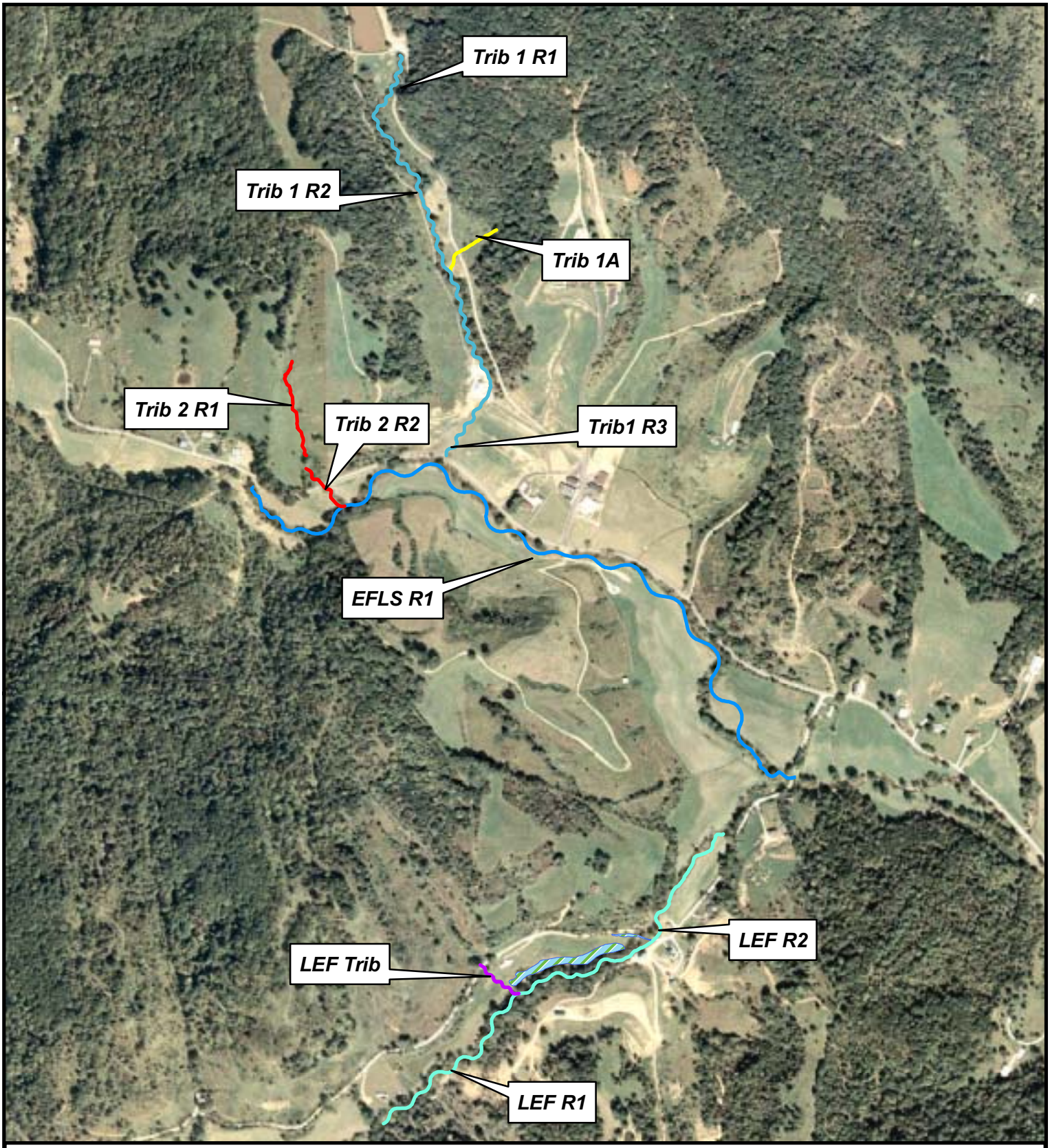
Signature and date of
Regulatory Project Manager
(REQUIRED)

Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining
the signature is impracticable)

SAMPLE

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
Trib1A	38.2270°N	82.7470°W	Riverine	371 linear feet/ 0.03 acre	Non-section 10 – non-wetland
Trib2-R1	38.2244°N	82.7507°W	Riverine	661 linear feet/ 0.05 acre	Non-section 10 – non-wetland

3. Jurisdictional Waters of the United States Map



Jurisdictional Waters of the United States
East Fork Little Sandy
Stream Restoration Project
Lawrence County, KY

East Fork of the Little Sandy River
Little East Fork
Little East Fork Trib
Tributary 1
Tributary 1A
Tributary 2
Wetlands

1 inch = 800 feet

0 800 1,600 Feet

N

The information on this map has been compiled by Stantec staff from a variety of sources and is subject to change without notice. Stantec makes no representations or warranties, expressed or implied, as to accuracy, completeness, timeliness, or rights to the use of such information.

V:\1756\active\17565005\engineering\GIS\EFLS_Project_Overview

IV. Mitigation Plan

1. Mitigation Plan

MITIGATION PLAN REPORT

East Fork Little Sandy
Stream Restoration Project
Lawrence County, Kentucky

Prepared for:

Kentucky Department of Fish and
Wildlife Resources

March 2009

Table of Contents

Table of Contents

APPENDICES

1.0 Baseline Information

1.1 SUMMARY AND PURPOSE

The project site is located in Lawrence County, Kentucky (see **Appendix A**) near the City of Louisa. The project is being completed through funding provided by the Kentucky Department of Fish and Wildlife Resources (KDFWR) In-Lieu Fee Program. The mitigation area consists of stream reaches along East Fork Little Sandy River, Little East Fork, and two headwater tributaries of East Fork Little Sandy River. The East Fork Little Sandy Stream Restoration Project has been divided into 10 reaches, as illustrated in **Appendix A**.

This project entails the restoration and enhancement of approximately 12,757 feet of stream. The proposed activity consists of the relocation of 9,511 feet of new stream channel within the project area. Steps will be taken to maintain channel grade, provide bank protection, and improve habitat within the new channel. Restoration activities include the relocation of some stream segments; the installation of in-stream structures that provide and enhance aquatic habitat, as well as provide erosion and grade control; reshaping of the existing channel for stability; and the planting of riparian vegetation to improve stability along the banks.

1.2 DETAILED LOCATION INFORMATION

From Louisville, take I-64 East to Exit 172; go south on Route 7 to Grayson. At Grayson, go south on Route 1 for approximately 9.5 miles to Willard. After Willard, turn left onto Route 1496. Travel approximately 8.7 miles on Route 1496 to the site. The majority of the project is located on Sunset Ranch.

1.3 RELATIVE GEOGRAPHIC LOCATION

The project is located within the Eastern Coalfield physiographic region within the Little Sandy River Watershed (HUC 050901414) (See **Figure 1.1**). This region is characterized by rugged mountains and is known for its abundance of coal.

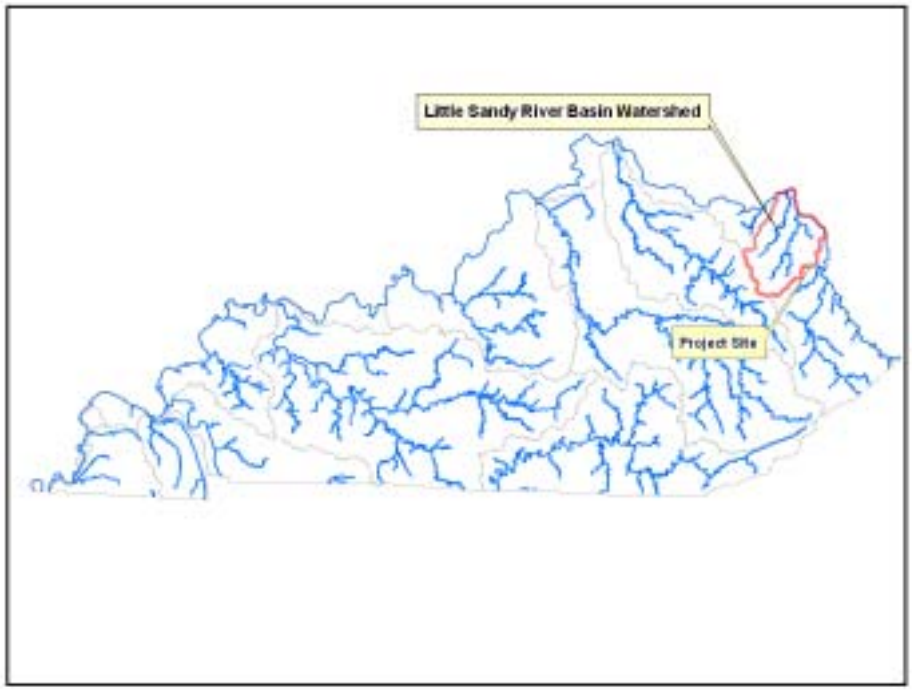


Figure 1.1 USGS Geographic Location within the Sandy River Watershed

1.4 SURROUNDING LAND USE

Land usage within the project area buffer is predominately grasslands with some mixed forest areas. The grasslands found along the banks of East Fork Little Sandy River, the Little East Fork, and Tributary 2 are mowed or cut for hay two to three times a year. The grasslands found on the lower one-third (1/3) of Tributary 1 are mowed regularly with mixed forest lands found on the remaining upper most part of the tributary.

1.5 STREAM CLASSIFICATION

The existing Rosgen stream types within the project area vary. **Table 1.1** summarizes the dimensions and stream classification for each existing reach of the project

Table 1.1 Stream Classification for East Fork Little Sandy Stream Restoration Project

Stream	Reach	Cross-section	W_{BKF} (ft)	D_{BKF} (ft)	W/D	Entrenchment Ratio	Level II Reach Classification
East Fork Little Sandy River	Reach 1	XS-3 Riffle	22.76	2.13	10.69	4.39	E5
Little East Fork	Reach 1	XS-504+00	16.02	1.13	14.18	2.27	C4
	Reach 2	XS-1 Riffle	12.82	1.43	8.97	11.7	E4
Tributary 1	Reach 1	XS 301+50	6.0	0.53	11.32	3.03	B4
	Reach 2	XS-2 STA 187.5	7.84	0.61	12.85	1.86	B4c
	Reach 3	XS 329+00	8.07	0.74	10.91	4.58	E4
Tributary 2	Reach 2	XS 207+50	6.2	0.53	11.7	5.64	E4b
Profiles, sections and detailed data for the surveyed cross-sections on East Fork Little Sandy are included in **Appendix B**.							

1.6 EXISTING CONDITIONS

East Fork Little Sandy River and its tributaries are headwaters to the Little Sandy River. The project involves approximately 12,757 feet of 1st, 2nd, and 3rd order streams. Streams located within the project area have been impaired from filling within the floodplain, channel relocation, and agricultural practices. Channel degradation is occurring, resulting in unstable banks, increased stream erosion and migrating channels. Both right and left banks are unstable throughout the project.

Stream habitat is poor throughout the project site. Habitat assessment scores indicate that the affected stream segments have diminished aquatic habitat functions. The upper section of East Fork Little Sandy River flows through a small wooded section and agricultural fields with sparse riparian protection in some places. The channel has been relocated against the toe of the hill causing sloughing of the banks. This section of stream channel is entrenched with eroding banks throughout; however, the channel has a good meander pattern. The middle and lower portion of East Fork Little Sandy River flows through large agricultural fields. Much of this reach has been straightened and relocated against State Route 1496. Both right and left banks are steep and unstable. Further downstream, the channel has two tight-contorted meanders, causing severe bank erosion.

Little East Fork converges with the East Fork Little Sandy River at the downstream end of the project site, just above a bridge crossing. The upstream portion of the affected stream channel along Little East Fork has been relocated against the toe of the adjacent hill causing sloughing.

The channel is entrenched with sparse riparian protection throughout. However, the right descending side of the upper section is wooded.

The majority of the channel of Tributary 1 is entrenched from down-cutting. The upper section has been relocated against an access road causing erosion in areas. This section of stream is in the widening phase of channel evolution and bankfull benches have formed in some places. The lower portion of Tributary 1 is straightened with no riparian zone as it flows through pastures.

Tributary 2 is located at the upstream end of the project site where it flows into the East Fork Little Sandy River. In the lower section of the tributary, the channel is entrenched and straightened. There are few trees on the lower portion of Tributary 2.

1.7 FIELD OBSERVATIONS

Each of the streams on the East Fork Little Sandy Stream Restoration Project was surveyed to collect data necessary for the classification of the existing stream types. Pebble counts were conducted to characterize bed materials and to estimate stream roughness. Samples were collected from bars for sieve analysis to characterize depositional materials for sediment transport competency calculations.

The existing stream profile, cross-sections, particle size analyses, and measured bankfull parameters for East Fork Little Sandy Stream Restoration Project are presented in **Appendix B**.

1.8 CLIMATE

Table 1.2 shows climate data for the East Fork Little Sandy River watershed. Climate data is not available at this time for Lawrence County, Kentucky and has been extrapolated with data from nearby Boyd County. Climate data was obtained from the Natural Resources Conservation Service (NRCS) website. **Table 1.2** includes the average and maximum temperature and precipitation values for Ashland, Kentucky. The annual average temperature is 53.2° F and the total annual precipitation is 42.61 inches. **Table 1.3** provides growing season dates and probabilities for the site based on the data from Ashland.

Table 1.2 Average Precipitation

	Temperature (∀F)			Precipitation (inches)				
				30% Chance will have				
Month	Average Daily Max	Average Daily Min	Average	Average	Less Than	More Than	Average # of days with 0.1 or More	Average Total Snow Fall
January	41.4	18.5	29.9	3.12	2.11	3.74	7	3.0
February	46.6	20.9	33.8	3.05	2.03	3.60	7	2.0
March	57.0	28.9	43.0	3.76	2.48	4.27	8	1.8
April	68.0	36.6	52.3	3.33	2.32	3.98	8	0.0
May	76.9	46.5	61.7	4.47	3.23	5.38	8	0.0
June	84.3	56.2	70.3	4.02	3.02	4.91	8	0.0
July	88.0	61.1	74.6	4.66	3.40	5.69	7	0.0
August	86.6	59.3	72.9	3.71	2.75	4.36	6	0.0
September	80.2	52.3	66.2	2.83	1.76	3.54	5	0.0
October	69.5	40.3	54.9	2.84	1.89	3.43	5	0.0
November	57.0	30.7	43.8	3.43	2.41	4.31	7	0.1
December	46.1	23.3	34.7	3.38	2.32	3.87	7	1.2
ANNUAL	---	---	---	---	37.48	44.74	---	---
AVERAGE	66.8	39.5	53.2	---	---	---	---	---
TOTAL	---	---	---	42.61	---	---	83	8.1

Table 1.3 Growing Season Dates for Ashland, Kentucky

Probability	Temperature		
	24° F or Higher	28° F or Higher	32° F or Higher
	Beginning and Ending Growing Season Length		
50% *	4/6 to 11/6	4/18 to 10/22	5/1 to 10/11
	213 days	187 days	163 days
70% *	3/31 to 11/12	4/13 to 10/27	4/27 to 10/16
	225 days	197 days	172 days
*Percent chance of the growing season occurring between the Beginning and Ending dates.			

1.9 WATER QUALITY

The project site is within the Eastern Coalfield Physiographic region. The conductivity measured near the end of the project site was 203 µS/cm.

1.10 FUNCTIONAL ASSESSMENT TOOL

The USEPA Rapid Bioassessment Protocol (RBP) for high gradient streams, was used to assess stream habitat quality for the project site. East Fork Little Sandy River is located within

the Mountain (MT) bioregion, which includes all river systems (Big Sandy, Cumberland, Kentucky, Licking, Little Sandy minor tributaries of the Ohio River) within the boundaries of the Central Appalachian Ecoregions (69). All reaches of East Fork Little Sandy River received a poor habitat quality rating (**Table 1.4)**. Selected photographs of the existing stream reaches and detailed data for the RBP assessments can be found in **Appendix C**.

Table 1.4 Habitat Quality Scale of Kentucky Streams by Bioregion as classified by RBP values[1]

Bioregion	Stream Habitat Quality	RBP Score/Stream Size	
		Headwater (<5.0 mi.^{2})	Wadeable (>5.0 mi.^{2})
Mountain	Excellent	Ø 160	Ø 160
	Average	117-159	117-159
	Poor	Ω 116	Ω 116

Following Eastern Kentucky Protocol, the initial and predicted RBP's and Conductivity were used to obtain the Ecological Integrity Indices (EII). From the EII, stream type ratio (according to ephemeral, intermittent, or perennial) and the project length, the overall credit/debit was determined.

Reference reaches used for the natural channel design for each project reach are given in **Table 1.5**.

Table 1.5 Reference Reaches

Project Reach	Reference Reach	Stream Type	Location
East Fork Little Sandy	East Fork Little Sandy Restored Reach	B5c	Lawrence County, Kentucky
Little East Fork Reach 1	Hyatt's Fork	C4	Pulaski County, Kentucky
Tributary 1, Reach 1, Reach 2	Flagg Spring Creek	B4c	Campbell County, Kentucky
Tributary 1, Reach 3	Hyatt's Fork	C4	Pulaski County, Kentucky
Tributary 2, Reach 2	Lower Brier Creek	C4b	Adair County, Kentucky

1.11 AERIAL PHOTOGRAPHY

Figure 1.4 was obtained from aerial photography provided by the National Agriculture Imagery Program. The photograph was taken in the spring of 2006. The blue lines show the project extents for East Fork Little Sandy Stream Restoration Project.

Figure 1.4 Aerial Photography of East Fork Little Sandy Stream Restoration Project

1.12 USDA/NRCS LAWRENCE COUNTY SOIL SURVEY SHEET FOR SITE

The soil survey map in the vicinity of the project site is shown in **Appendix A**. The map was obtained from *http://kgsweb.uky.edu/download/geology/soils/soilspick.htm*. Soil types and descriptions of the soils found in the site area are given in **Table 1.6**. Holly silt loam, found along the Little East Fork (Ho) is the only hydric soil located within the project area containing 90% hydric soils. The dominant soil in the vicinity of the site is the Hayter-Grigsby complex.

Table 1.6 Soil Descriptions

Soil Symbol	Soil Description
HaC	Hayter-Grigsby complex, 2 to 15 percent slopes
VaF2	Vandalia-Beech complex, 20 to 60 percent slopes
UpD	Upshur-Rarden complex, 12 to 25 percent slopes
Ho	Holly silt loam, frequently flooded
HaC	Hayter-Grigsby complex, 2 to 15 percent slopes

1.13 RESPONSIBLE PARTIES

The Kentucky Department of Fish and Wildlife Resources (KDFWR) is the responsible party for this stream restoration project. The contact person at KDFWR is Benjamin Kinman. Permit preparation was completed by Stantec Consulting Services Inc. and the contact person is Stephen D. Hall. Property owners and point of contact information are listed in **Table 1.7**.

Table 1.7 Contact Information

Adjoining Property Owners				
Owner	**Address**	**City, State**	**Zip Code**	**Phone**
Mr. Jack Holcomb	Sunset Ranch 800 Hwy 1496	Louisa, KY	41230	606-686-1100
Mr. Elmer Lucas	Route 1, Box 129	Salt Rock, WV	25559	304-736-9707
Mr. James Metz	513 Little East Fork Rd	Louisa, KY	41230	606-686-2793
Mr. Bill Morehead	PO Box 3222	Louisa, KY	41230	606-686-9267
Mr. Carl Kirk	345 Little East Fork Rd	Louisa, KY	41230	606-686-3369
Project Contacts				
Name	**Organization**	**Address**		**Phone**
Benjamin Kinman	KY Department of Fish and Wildlife Resources	#1 Sportsman's Lane Frankfort, KY 40601		(502) 564-3440 Ext:4466
Stephen D. Hall	Stantec Consulting Services Inc.	350 Missouri Ave, Ste 100 Jeffersonville, IN 47130		(812) 285-4060

1.14 PROPOSED MITIGATION SITE

The project reach was identified by the KDFWR as a potential mitigation site for impacted streams within the Little Sandy River Watershed (HUC06040006). In-lieu fees paid to mitigate stream losses in the watershed are being used to design and construct the project.

The site was selected because its existing conditions and potential for improvement. Stream reaches on the East Fork Little Sandy Restoration Project lack aquatic habitat, riparian

vegetation, proper stream form and overall stability. Most of the stream reaches are incised and lack connection with the floodplain.

The proposed mitigation project will allow access to the floodplain, prevent further headcutting in stream reaches, reduce erosion, and improve aquatic and riparian habitat along the project reach. Details of the proposed design plans are included in **Section 3.0** and **Appendix G**.

The mitigation site is protected by a conservation easement between the landowners and the KDFWR.

2.0 Goals and Objectives

This project is being constructed by the Kentucky Department of Fish and Wildlife Resources, with funding from the Kentucky In-Lieu Fee Program. The purpose of the program is to utilize fees paid for unmitigated stream impacts to provide mitigation by improving and restoring the function and value of streams in the Commonwealth. The restoration plan for the project has been designed to improve the functions and values of the affected stream reaches and is presented in **Section 3.0**.

2.1 FUNCTION AND VALUES

The function of streams includes physical, chemical, and biological processes that support self-sustaining reaches which provide healthy habitats for aquatic and riparian plant and animal species. Higher functioning streams are valuable fisheries, have better water quality, and improved wildlife populations and diversity.

In its existing state, the project reach on East Fork Little Sandy is characterized by the lack of effective riparian vegetation, poor floodplain access, and unstable banks. The lack of shading by riparian vegetation along reaches causes elevated water temperatures and reduces dissolved oxygen levels.

Unstable banks are easily eroded and can be a significant source of sediment that impairs fish and macroinvertebrate communities. Bank instability is generally caused by the removal of trees and woody vegetation from the stream banks. Roots of trees and vegetative cover act to reinforce soils and bind the soil mass. In addition to stabilizing and shading stream banks, leaf litter from trees and woody vegetation provides a food source and habitat for many macroinvertebrates in the stream.

For this project only, abiotic factors of the Eastern KY Stream Assessment Protocol (EKSAP) were needed. Thus, only RBP habitat scores and conductivity were used. The RBP involves components such as riparian width, bank stability, and embeddedness. The existing RBP scores along East Fork Little Sandy and related tributaries and the expected post-construction

scores (after vegetation establishment) are below in **Table 2.1.** Details of the RBP scores are included in **Appendix C**.

Table 2.1 RBP Scores

Reach	Pre-Construction	Post-Construction
EFLS R1	97	162
LEF R1	81	162
LEF R2	79	140
LEF Trib	65	160
Trib 1 R1	108	163
Trib 1 R2	115	164
Trib 1 R3	94	162
Trib 1A	99	144
Trib 2 R1	94	147
Trib 2 R2	86	163

2.2 FUNCTIONAL REPLACEMENT

The purpose of this project is to mitigate stream loss in the Big Sandy River watershed. Stream design for this project was conducted using Natural Channel Design techniques, which employs a holistic approach to stream restoration whereby the creation of habitat and preservation of stream function is emphasized equally with physical stability. Riparian corridor establishment is also a component of natural channel design projects as the presence of tree root structures will enhance the stability of the new stream channel. In addition, tree vegetation provides shade and ecological enhancements to the stream ecosystem.

2.3 EXPECTED MITIGATION CREDITS

The expected mitigation credits are based on the success criteria for streams and wetlands. Success Criteria for this project is presented in **Section 4.0**. These criteria are based on expected values at each of the five monitoring years. Due to the location of the projects location with in the Eastern Coalfields region of Kentucky, mitigation credits have been calculated using the EKSAP developed by the United States Army Cops of Engineers (USACE). A summary of the expected mitigation credits for the East Fork Little Sandy Stream Restoration Project is presented in **Table 2.2**, as discussed below. Stream credit calculations are presented in **Appendix E**.

Table 2.2 Mitigation Credits

Reach	Net Credits
EFLS R1	2,842
LEF R1	1,018
LEF R2	477
LEF Trib	94
Trib 1 R1	216
Trib 1 R2	482
Trib 1 R3	263
Trib 1A	53
Trib 2 R1	86
Trib 2 R2	126
TOTAL	**5,656**

3.0 Mitigation Design and Plan Implementation

The proposed design plan is included in **Appendix G**. It includes the following components:

- Relocation of approximately 9,511 linear feet of stream on East Fork Little Sandy and related tributaries, restoration and enhancements of approximately 12,757 total linear feet of stream on the entire project.
- Construction of log vane/rootwad combinations, constructed riffles, and rock cross vanes in East Fork Little Sandy to increase bank stability and aquatic habitat.
- Rock and log step pool construction to provide gradual grade control
- Seeding of the riparian corridor
- Tree planting in the riparian corridor

Structures designed to increase the stability of banks as well as provide valuable in-stream habitat will be constructed in the reaches of East Fork Little Sandy River. Log vane/rootwad combinations will promote the formation of pools, provide diverse aquatic habitat, and protect the outside meander bends of the reaches. Cross vanes will be used to protect banks, provide grade control, direct flow to the center of the stream while maintaining stream power, and maintain scour pool habitat.

The riparian corridor will be seeded and planted along East Fork Little Sandy. Two planting and seeding zones have been established along the reaches. Zone 1 includes areas that are at or below the bankfull or flood prone elevation. Zone 2 covers areas above the flood prone area.

Planting plans showing planting limits are included in **Appendix G**. **Table 3.1** contains a listing of plants proposed for the revegetation areas. There are two zones, as mentioned above.

Only native plants will be used in the riparian planting zones. Seeds and plants were selected based on their hardiness in the Eastern Coalfields region, ease of stand establishment, and their ability to provide food and refuge for wildlife. Planting and seeding schedules for Zones 1 and 2 are provided in **Table 3.1**.

Current land uses and overall stream instability contribute significant volumes of sediment to the stream from bank erosion. The channel design and hydraulic structures will promote the movement of sediment through the stream reach. This will prevent silt disposition in the stream bed that can degrade aquatic habitats. The mitigation plan does not include provisions should the development of the watershed result in base flow losses.

Seeding Rates for Permanent Ground Cover: The seeding rates for permanent ground cover are shown in **Table 3.1** below.

Table 3.1 Permanent Planting and Seeding Mixtures and Rates

ZONE 1 – Bankfull Bench			
Common Name	**Species Name**	**Stems per acre**	**Frequency (%)**
SHRUBS			
Buttonbush	*Cephalanthus occidentalis*	72	20
Silky Dogwood	*Cornus amomum*	72	20
Common Alder	*Alnus serrulata*	72	20
Elderberry	*Sambucus canadensis*	72	20
Arrowwood	*Viburnum dentatum*	72	20
	Total	**360**	**100**
TREES			
Black Willow	*Salix nigra*	30	15
Cottonwood	*Populus deltoides*	30	15
Green Ash	*Fraxinus pennsylvanica*	30	15
Pin Oak	*Quercus palustris*	40	20
Swamp White Oak	*Quercus bicolor*	40	20
River Birch	*Betula nigra*	30	15
	Total	**200**	**100**

ZONE 2 – Above Bankfull Bench			
Common Name	**Species Name**	**Stems per acre**	**Frequency (%)**
SHRUBS			
Black Haw	*Viburnum prunifolium*	72	20
Witch-hazel	*Hamamelis virginiana*	72	20
Redbud	*Cercis canadensis*	72	20
Spicebush	*Lindera benzoin*	72	20
Arrowwood	*Viburnum dentatum*	72	20
	Total	**360**	**100**
TREES			
Flowering Dogwood	*Cornus florida*	24	10
Sugar Maple	*Acer saccharum*	24	10
Sweet gum	*Liquidambar styraciflua*	24	10
Persimmon	*Diospyros virginiana*	24	10
White Ash	*Fraxinus americana*	24	10
White Oak	*Quercus alba*	48	20
Red Oak	*Quercus rubra*	48	20
Black Walnut	*Juglans nigra*	24	10
	Total	**240**	**100**
Permanent Ground Cover – Zones 1 & 2			
Common Name	**Species Name**	**Pounds of PLS per acre**	**Frequency (%)**
GRASSES			
Big Bluestem Grass	*Andropogon gerrardii*	10	20
Little Bluestem Grass	*Andropogon scoparius*	10	20
Fowl Mannagrass	*Glyceria striata*	5	10
Indian Grass	*Sorghastrum nutans*	5	10
Switchgrass	*Panicum virgatum*	10	20
Virginia Wild Rye	*Elymus virginicus*	5	10
Tioga Deertongue	*Panicum clandestinum*	5	10
	Total	**50**	**100**

SEDGE & FORB			
Fox Sedge	*Carex vulpinoidea*	1.0	10
Frank's Sedge	*Carex frankii*	1.0	10
Soft Rush	*Juncus effusus*	1.0	10
Black-Eyed Susan	*Rudbeckia hirta*	2.0	20
New England Aster	*Aster novae-angliae*	1.0	10
Grass-leaved Goldenrod	*Solidago = (Euthamia) graminifolia*	1.0	10
Tall Goldenrod	*Solidago altissima*	1.0	10
Bonset	*Eupatorium perfoliatum*	0.5	5
Beggar Ticks	*Bidens frondosa*	1.5	15
	Total	**10**	**100**

- Nursery Stock Units – All shrubs and trees to be bare root.
- Spacing – Trees and shrubs to be spaced on average on a 9ft x 9ft grid.
- Spacing Pattern – Tree and shrub species to be distributed in a random order.
- PLS = Minimum Pure Live Seed Percentage.
- All seed to be broadcast and raked into soil.

Live Stakes: Live stakes may be substituted (species for species) for appropriate trees/shrub seedlings in **Zone 1**, if desired. Those species that do well as live stakes in **Zone 1** include silky dogwood, black willow, and elderberry. Live stakes need to be driven into the ground at a depth of approximately 60% to 70% of their length, if possible. Spacing of live stakes (as approved by engineer) will be consistent with planting Zone 1 spacing.

Bare Root Seedling Sizes: Seedling sizes will vary by species. The contractor is to plant seedlings of adequate size for each species such that the seedlings will be viable under expected growing conditions. The contractor is ultimately responsible for the success of seedling plantings for one year after construction, under the terms of the project warranty. If species can not be obtained as bare root seedlings, then the contractor may use the smallest container stock available.

3.1 CONSTRUCTION SCHEDULE AND OBSERVATION

The construction schedule will be set by the contractor. Provisions are included in the design drawings regarding appropriate planting schedule for items that require planting during the dormant season. The surveying portion of yearly monitoring will likely take place in the absence of leaf cover. Photo documentation, however, will take place during the growing season and during dormancy.

Construction observation will be provided by Stantec. A field engineer will be available throughout the construction process and will assist the contractor with the construction of the East Fork Little Sandy Stream Restoration Project.

3.2 SITE PREPARATION

Preparation of the site for construction will include the installation of stabilized construction entrances, silt fence, and sediment controls shown on the erosion and sediment control plan. Trees not to be disturbed will be identified and protected with orange barrier fencing.

Trees and vegetation will be cleared from areas where bankfull benches will be constructed in a phased process. Trees suitable for the construction of rootwad and habitat structures will be salvaged. The staging area and stockpile areas for construction materials will be established.

Spoil disposal areas will be identified adjacent to the project area. These areas will be cleared and grubbed. Topsoil will be removed from the spoil disposal areas and stockpiled for use in topsoil replacement.

Relocation reaches will be constructed in the dry while stream flow is maintained through the existing channel. Fill will then be placed to cut off stream flow to the abandoned channel reaches upon completion of the relocated stream.

The riparian corridor will be seeded and planted along the project site. Construction notes include directions for the contractor to minimize compaction in the planting zone or, if applicable, disk the soil prior to planting seeds and plant stock.

3.3 AS-BUILT CONDITIONS

Within six weeks of the completion of the mitigation project, KDFWR will obtain an as-built survey of the site. The as-built report will be submitted with the Year 1 monitoring report to the USACE describing the as-built status of the project, including initial planting list and plan, updated credit/debit tables, narrative, and a monitoring schedule. Stream dimensions, plan, and profile information will be collected during the as-built survey. Specific data collected during the as-built survey will include plan form measurements, longitudinal profiles throughout the mitigation site, cross-sections, monument locations, RBP scores, revised credit/debit table, and photo documentation. A brief narrative describing any deviation from the approved mitigation plan will accompany the as-built plans and report. Maintenance items will be addressed on an as-needed and scheduled basis. The mitigation site will be identified with permanent signs while monitoring locations will be marked with permanent monuments.

3.4 FINANCIAL ASSURANCES

Kentucky Department of Fish and Wildlife Resources will allocate any necessary monies for implementation and maintenance of the project.

4.0 Success Criteria

Project specific success criteria are established and presented in **Appendix H**. The success criteria are divided into three categories; geomorphology, vegetation, and habitat value. Geomorphology and vegetation success criteria establish a minimum performance standard for the implementation of the restoration project design. In contrast, the habitat success criteria establish a minimum performance standard of the restoration project goal. The monitoring methods described in **Section 5.0** will collect the data necessary to evaluate the project against the success criteria. The success criteria presented in **Appendix H** have annual targets up to the fifth year. The sections below summarize the success criteria that are to be obtained at the end of the five-year monitoring period.

4.1 GEOMORPHOLOGY CRITERIA

- **Riffles:**
  - Maintain Bankfull dimensions to within 50% of design criteria.
- **Pools:**
  - Maintain Bankfull dimensions to within 50% of design criteria.
- **Expected number of cumulative bankfull events:**
  - Three after five years.
- **Channel, Banks, and Structures:**
  - No significant scour, sedimentation, erosion, or sloughing of channel and banks; and
  - Structure function and integrity is maintained.

4.2 HABITAT CRITERIA:

- **Habitat Value:**
  - Maintain a minimum RBP score of 146.

4.3 VEGETATION CRITERIA:

- Woody Vegetation:
  - Native species to account for a minimum of 300 stems per acre;
  - Native species to account for a minimum of 80% of total stem count;
  - Invasive/exotic species to account for a maximum of 10% of total stem count (invasive/exotic species will not be counted as volunteers); and
  - Any one species to account for a maximum of 25% of total stem count.
- Herbaceous Vegetation:
  - Vegetation to account for a minimum of 80% of total cover;
  - Native species to account for a minimum of 80% of vegetative cover;

- Invasive/exotic species to account for a maximum of 10% of vegetative cover (invasive/exotic species will not be counted as volunteers); and
- Any one species to account for a maximum of 25% of vegetative cover.

- Total Plant Species List:
  - Plant species that have been observed at the site.

Exotic/invasive species are those species listed on the Exotic Plants List published by the Kentucky Exotic Pest Plant Council. Listed species will be removed from the mitigation area prior to planting. If these species are present in numbers that exceed the success criteria during monitoring, they will be removed during the monitoring year so that the exotic/invasive species criteria are met.

If the vegetation on this site fails to meet the success criteria and replanting of vegetation is required, the following measures will be taken.

- During Year 1 of monitoring, native stem density numbers may fall below outlined success criteria for vegetation by up to 25% without requiring a re-start of the vegetation monitoring years, **if** the failed areas are replanted to have a total of at least 400 stems/acre (by April of Year 2 monitoring).

- During Year 2 of monitoring, native stem density numbers may fall below outlined success criteria for vegetation by up to 15% without requiring a re-start of the vegetation monitoring years, **if** the failed areas are replanted to have a total of at least 400 stems/acre (by April of Year 3 monitoring).

- During Year 3 of monitoring, native stem density numbers may fall below outlined success criteria for vegetation by up to 5% without requiring a re-start of the vegetation monitoring years, **if** the failed areas are replanted to have a total of at least 400 stems/acre (by April of Year 4 monitoring).

- If native vegetation along the stream site fails to meet the success criteria by any greater percentages (as outlined above) **or** in any later years than monitoring Year 3, negotiations with the USACE will be made prior to remediation of the vegetation and the USACE may require vegetation monitoring of five years minimum to re-start.

4.4 HOW SUCCESS CRITERIA SUPPORT THE GOALS AND OBJECTIVES

Geomorphology, habitat, and vegetation success are all evaluated as part of the RBP scoring. The RBP includes metrics for evaluating the channel stability, fish cover, facet creation and riparian zone as described in the Goals and Objectives section of this document.

5.0 Monitoring

Monitoring of the site will commence after construction and during the first full growing season. Monitoring will continue for a minimum of five years or until released from monitoring by the USACE. The site will be monitored for the geomorphologic stability of the channel, the growth of riparian vegetation, and the habitat value index of the entire system. In addition, the methods are designed to yield results in a format that is directly comparable to the success criteria outlined in **Section 6.0**.

5.1 MONITORING SCHEDULE

Monitoring of the site will be conducted in accordance with the schedule outlined in **Table 5.1**. Monitoring of habitat value and visual inspection of channel geomorphology will occur once a year with cross-sections being conducted during Year 5 only. Visual inspections of in-stream structures and bank scours can be made during any site visit; however, a comprehensive inspection is scheduled once a year. Vegetation plots will be monitored once each year. Photo monitoring will be conducted twice a year; once at the beginning of the growing season and again towards the end of the growing season. Personnel performing the evaluation will be landscape ecologists, taxonomists, botanists, and civil engineers. It is expected that Stantec will conduct the project monitoring and reporting.

5.2 METHODOLOGY FOR MEASUREMENT

5.2.1 Geomorphology

The most critical channel dimensions for natural channel design are riffle dimensions. Not only are riffle dimensions the basis for stream classification, they also establish the stage of upstream waters (providing grade control). Pool dimensions are second in importance because their morphology impacts the flow characteristics of runs and glides. Pools are typically excavated to varying depths and are made deep where feasible. Runs and glides are transitions between the riffles and pools and may vary to some degree in dimension without detriment to the geomorphologic stability of the riffles and pools. In this design, runs and glides are not specifically dimensioned. The following success measurements will be reported:

Cross-sections: A total of eight cross-section stations will be established and measured during the as-built survey. These stations will also be surveyed during the fifth annual monitoring period.

Table 5.1. Monitoring Schedule.

Component	Data Collection	As-Built	Year 1		Year 2		Year 3		Year 4		Year 5	
			Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
Geomorphology	Cross-sections - Riffles and Pools	X									X	
	Grade & Habitat Structure Visual Inspection	X		X		X		X		X		X
	Photograph Restored Reach(s)	X	X	X	X	X	X	X	X	X	X	X
Habitat	RBP (low gradient, habitat)			X		X		X		X		X
Vegetation	Stem Count - Trees & Shrubs	X		X		X		X		X		X
	Percent Cover - Herbaceous Plants	X [1]		X		X		X		X		X
	Photograph Riparian Zones	X	X	X	X	X	X	X	X	X	X	X
	Total Plant Species List	X		X		X		X		X		X

NOTE: Data collected during the Early and Late growing season monitoring events will be reported in the Annual Monitoring Report of that Year. The Annual Monitoring Reports will be submitted to the USACE and Section 401 Water Quality Certification Agency by January 31st of the following year.

X Data Collection Completed

[1] Data collection will only confirm that the entire area was seeded with approved restoration mix.

Expected Number of Cumulative Bankfull Events: Bankfull event observations can be documented using the following methods:

- Rack/raft line observations;
- Stage recording devices:
- Direct observations; and
- Use of a local gage/collaborative source to make observations.

Assuming a bankfull event is equivalent to an event with a 1.2- to 1.5-YR return period, the probability of bankfull flow being equaled or exceeded in any year is 67 to 83%. Over the five-year monitoring period 3 to 4 bankfull events can be expected.

Grade & Habitat Structure Visual Inspection: A visual survey of the restored reach will be conducted once a year. The condition of each in-stream structure and the condition of channel bank will be inspected. Casual observations of in-stream structures and the condition of the channel bank can be made during any site visit.

Photograph Restored Reach(s): The quantity and location of photographic documentation stations will be established during the as-built survey. Stations will be located at strategic points where upstream and downstream views include images of critical structures and channel morphology.

5.2.2 Habitat

Habitat value will be measured using the RBP developed by the USEPA (USEPA, 1999). According to the *Standard Methods for Assessing Biological Integrity of Surface Waters in Kentucky* (February, 2008, Revision 3), Trammel Creek is within the Pennyroyal Bioregion and will require a minimum RBP value of 146 to be considered excellent habitat quality (see **Section 1.10** and **Table 1.4**).

RBP Stations: The quantity and location of RBP stations will be established during the as-built survey. However; since there are two basic restoration treatments (channel restoration and Bankfull bench only), a minimum of two RBP stations will be established. In general, RBP stations will be located where the upstream and downstream conditions at each station are typical of the reach being monitored.

5.2.3 Vegetation

Vegetation will be monitored through a combination of stem count measurements for planted and volunteer woody species and percent coverage measurements for herbaceous species. Stem counts will be conducted in each planting zone area via belt-transect method. Percent coverage measurements will be conducted in each planting zone area via quadrat (plot-subplot) method. The size, orientation, and number of sampling plots and transects will be established in the field during the as-built survey and included in the as-built report.

Stem Counts (Woody Vegetation): Stem counts are proposed to assess woody stem densities at the site. Stem counts will be conducted along belt-transects that will be two (2) meters wide and have variable lengths in Zones 1 and 2. Woody Belt-transects will be field-measured using an open reel measuring tape, and marked by survey stakes. Observed woody species, including planted and volunteer specimens, will be counted.

Percent Cover (Herbaceous Vegetation): Percent coverage measurements are proposed to assess herbaceous species composition at the site. Percent coverage measurements will be conducted within sample plots of variable dimensions in both planting zones. Sample plots will be established in the field using open reel measuring tapes, and will be marked by survey stakes. Each sampling plot will have a series of one meter square sub-plots called quadrats. The percent cover of herbaceous vegetation, by species, and bare ground will be measured within these quadrats.

Photograph Riparian Vegetation (Vegetation Plots): Each belt-transect and sampling plot will be photographed during each monitoring event. The location and orientation of the photographs will be located on the annual reports.

5.3 MONITORING REPORTS

Annual monitoring reports, consistent with RGL-08-03 (USACE) and will be submitted to KDOW and USACE by January 30th of the year following each monitoring period. Monitoring reports will include the updated debit/credit ledger, success criteria measurements, photographs, and maps of monitoring locations.

5.4 RELEASE FROM MONITORING

Once the project has been monitored for a minimum of five years and has met the success criteria, KDFWR will request, in writing, release from monitoring. The request will include the following:

- Final Monitoring Report, including an evaluation of project success and final success criteria metrics;
- Final credits based on project success; and
- Jurisdictional Determinations for any created Waters of the U.S.

The USACE shall conduct a final site visit and notify KDFWR in writing whether release form monitoring is deemed appropriate or what additional information, corrective measures, or additional monitoring is necessary for the USACE to approve monitoring release.

6.0 Contingency Plan

Should the project fail to meet the criteria as outlined herein, several options may be available. The initial step will be to determine the likely cause of failure. To remediate for the failure to meet these criteria, one of the following actions may be taken:

- Correction of the deficiency, if feasible;
- Extension of the monitoring period, for vegetation growth, et al.; and
- Other methods of correction not specified at present, but permissible under future regulatory guidelines.

6.1 POTENTIAL MITIGATION CHALLENGES

As with virtually all stream restoration projects of this kind, several potential challenges exist. Flooding is generally the foremost concern, particularly during the period immediately following construction. Natural Channel Design relies on stable channel dimensions and the reinforcing action of bank vegetation to aid in resisting erosion. As the establishment of a root mass takes time, the stream is in its most vulnerable state immediately after construction. Erosion control measures are included to bridge the time gap between construction completion and the establishment of the root mass. Drought conditions during the first growing season can severely impair the ability of the vegetation to become established. Invasive species can potentially out-compete the riparian plantings on restoration projects.

In the event these or other challenges create a condition whereby success criteria are not met, corrective actions may be implemented. Corrective actions include, but are not limited to:

- Supplemental seeding of temporary ground cover or permanent herbaceous vegetation;
- Supplemental planting of native tree and shrub species;
- Culling of established vegetation;
- Herbicide treatments (in accordance with label instructions);
- Re-setting or re-installing erosion controls including erosion control blankets along the channel bank;
- Re-grading channel and floodplain to meet dimension criteria; and
- Re-setting or re-building grade control structures and habitat structures.

6.2 CORRECTING DEFICIENCIES & PRE-AUTHORIZATION

The preference of KDFWR is to correct deficiencies and to develop a cooperative relationship with the USACE and KDOW to promote the success of the project. KDFWR will seek pre-authorization for planned corrective measures from the USACE whenever practical. However, it is important to react swiftly to deficient situations before they become problematic. Therefore, as a matter of practicality, the KDFWR may implement corrective measures to meet annual and

final success criteria without seeking pre-authorization of the USACE under the following conditions:

- The corrective measures are implemented in accordance with other federal and state regulations and are otherwise legal;
- The corrective measures are implemented within the range of acceptable limits established by the mitigation design and with materials presented in the mitigation plan; and
- The corrective measures are fully explained in the subsequent annual (or final) monitoring report.

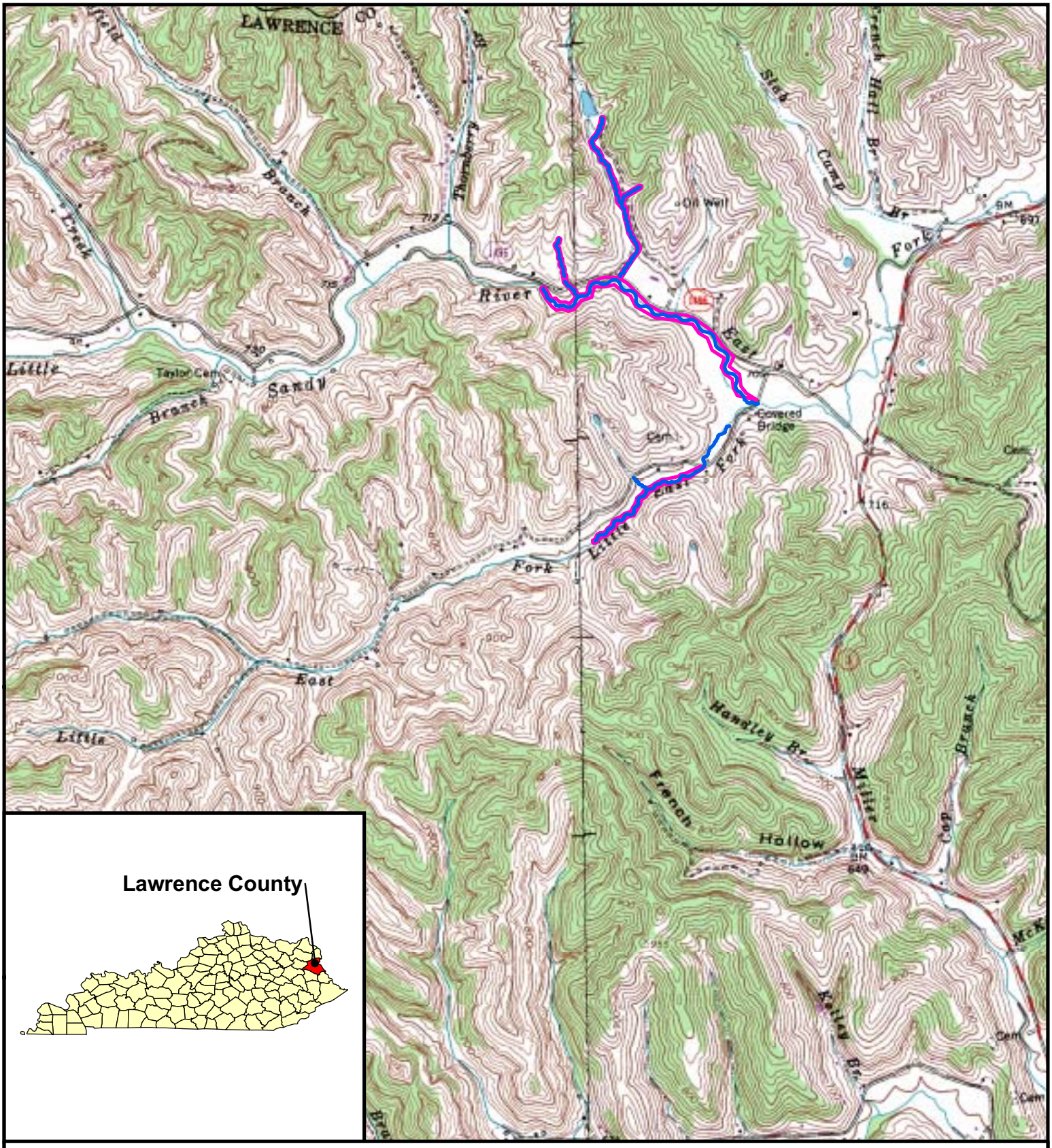
If the proposed corrective measures will result in a feature or landscape outside of the design criteria, or will be constructed with different materials, prior authorization from the USACE will be required. For example, it is acceptable to augment the woody stem count with additional native tree and shrub species to obtain the success criterion without prior regulatory approval. The subsequent annual report would describe the deficiency and the specifications of the supplemental plantings. However, pre-authorization would be required if tree species not listed in the original design were used.

Literature Cited:

Sparks, J., T. Hangman, D. Messer, and J. Townsend. 2003. Eastern Kentucky stream assessment protocol: Utility in making mitigation decisions. *Aquatic Resources News: A Regulatory Newsletter* 2(2) : 4-10.

2. Attachments

Appendix A – Maps



Project Location Map
East Fork Little Sandy River
Lawrence County, KY

N

1 inch = 2,000 feet

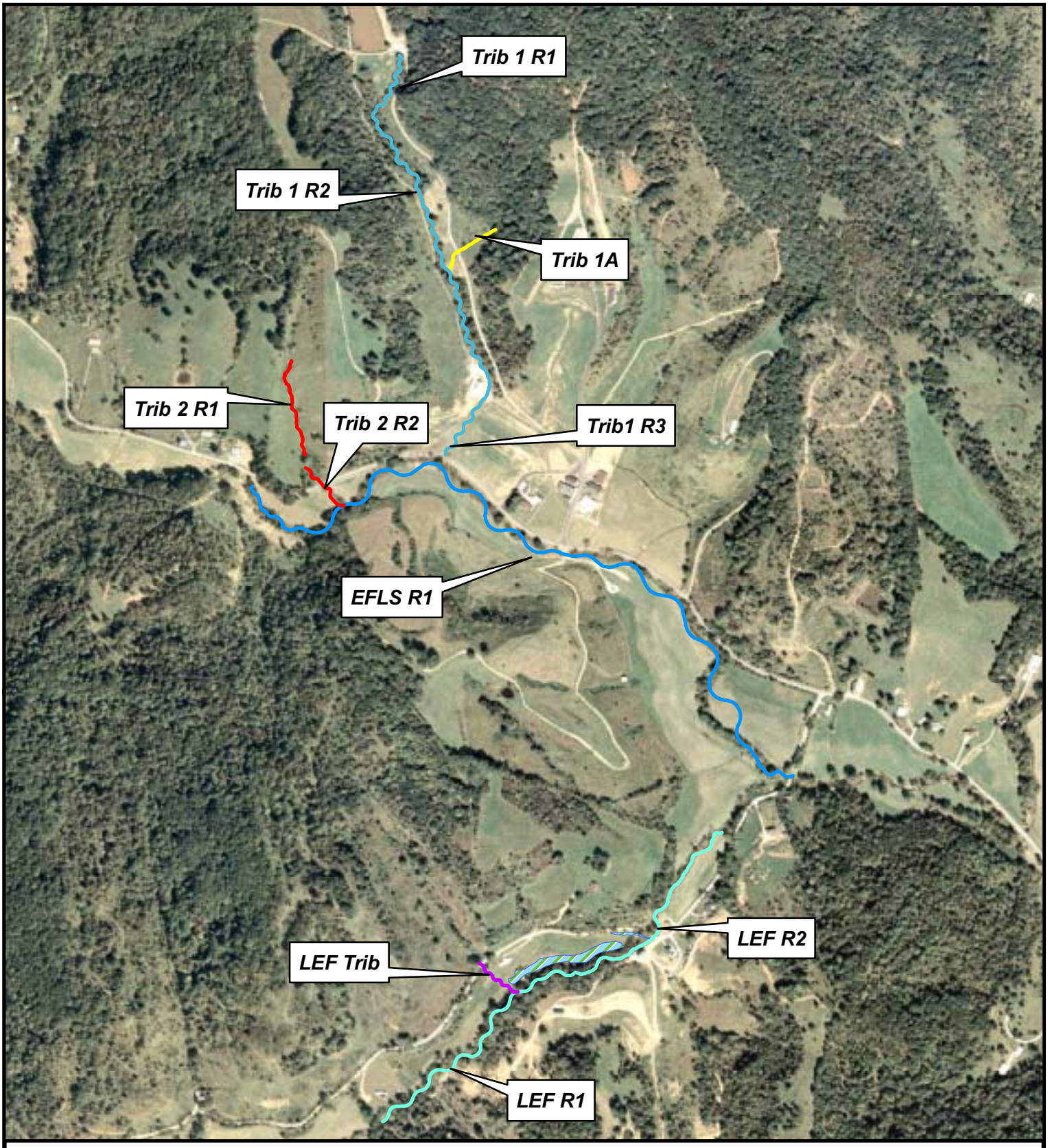
0 2,000 4,000 Feet

Stantec

Proposed Stream Center Line

Project Extents

V:\1756\active\17565005\engineering\GIS\EFLS_LocationMap



Reach Location Map
East Fork Little Sandy
Stream Restoration Project
Lawrence County, KY

1 inch = 800 feet

0 800 1,600 Feet

N

East Fork of the Little Sandy River
Little East Fork
Little East Fork Trib
Tributary 1
Tributary 1A
Tributary 2
Wetlands

Stantec

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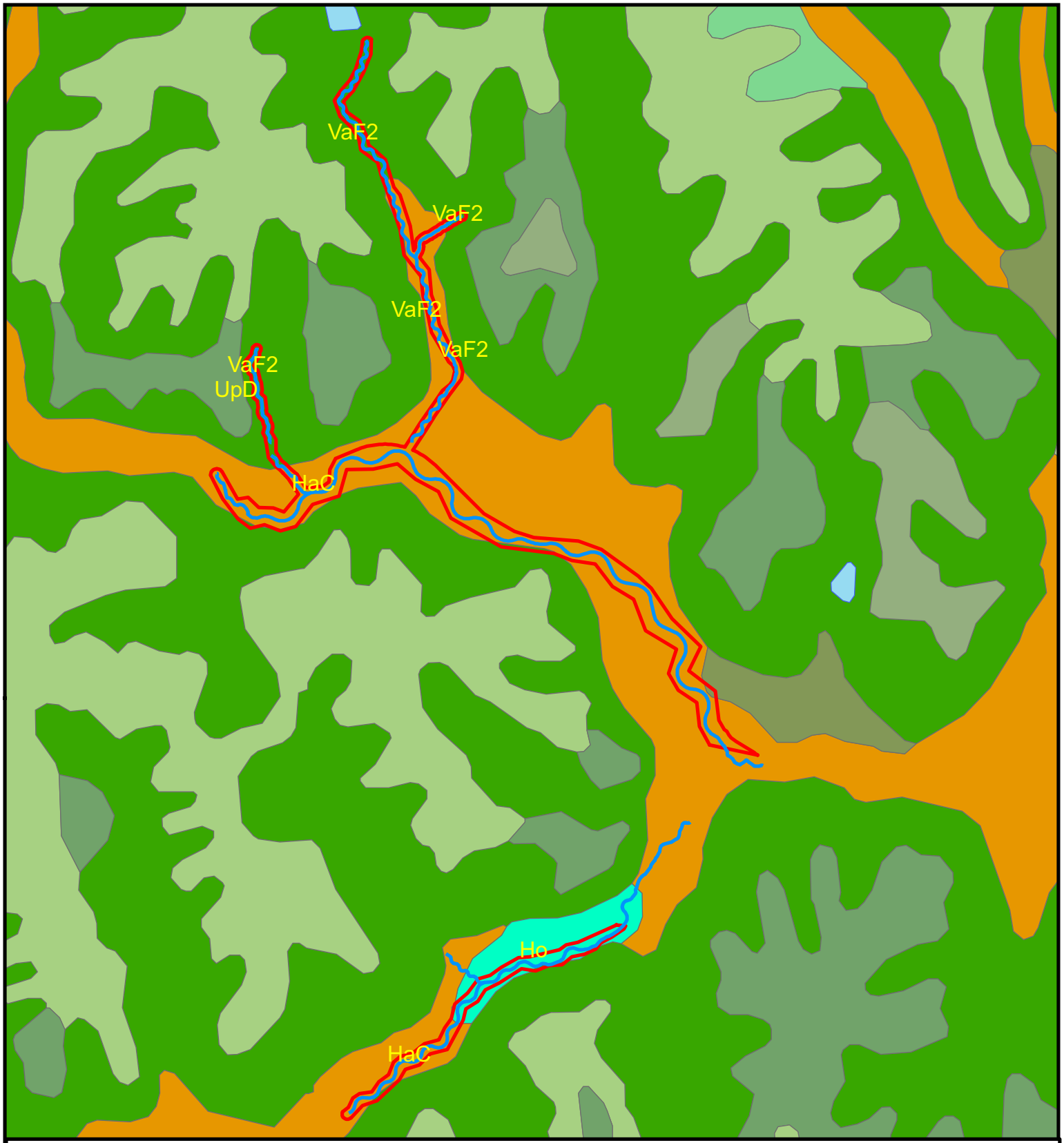

Soils Map
East Fork Little Sandy
Stream Restoration Project
Lawrence County, KY

Proposed Stream Center Line

Project Extents

Hydric Soils

N

1 inch = 800 feet

0 800 1,600 Feet

Stantec

The information on this map has been compiled by Stantec staff from a variety of sources and is subject to change without notice. Stantec makes no representations or warranties, expressed or implied, as to accuracy, completeness, timeliness, or rights to the use of such information.

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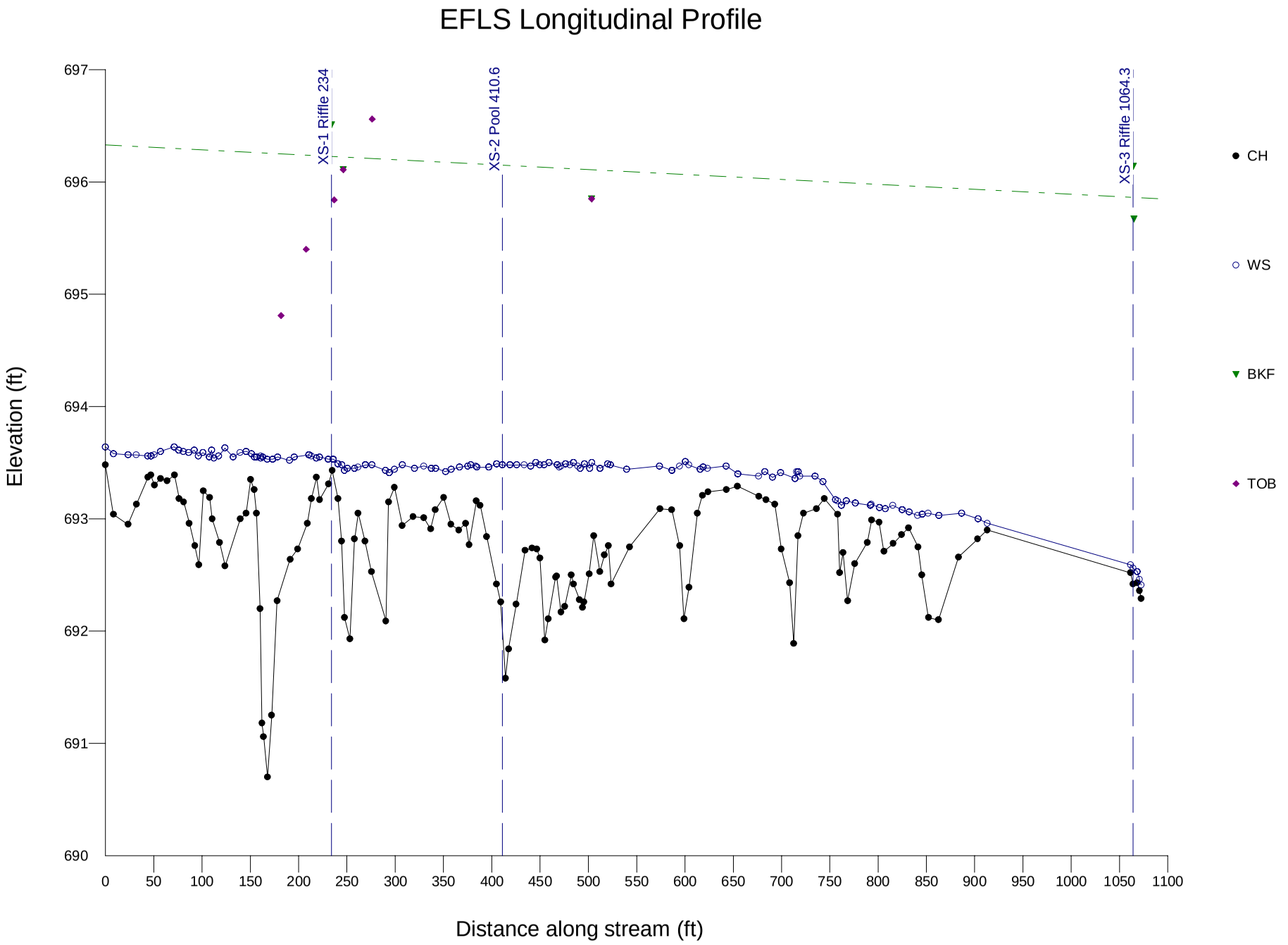
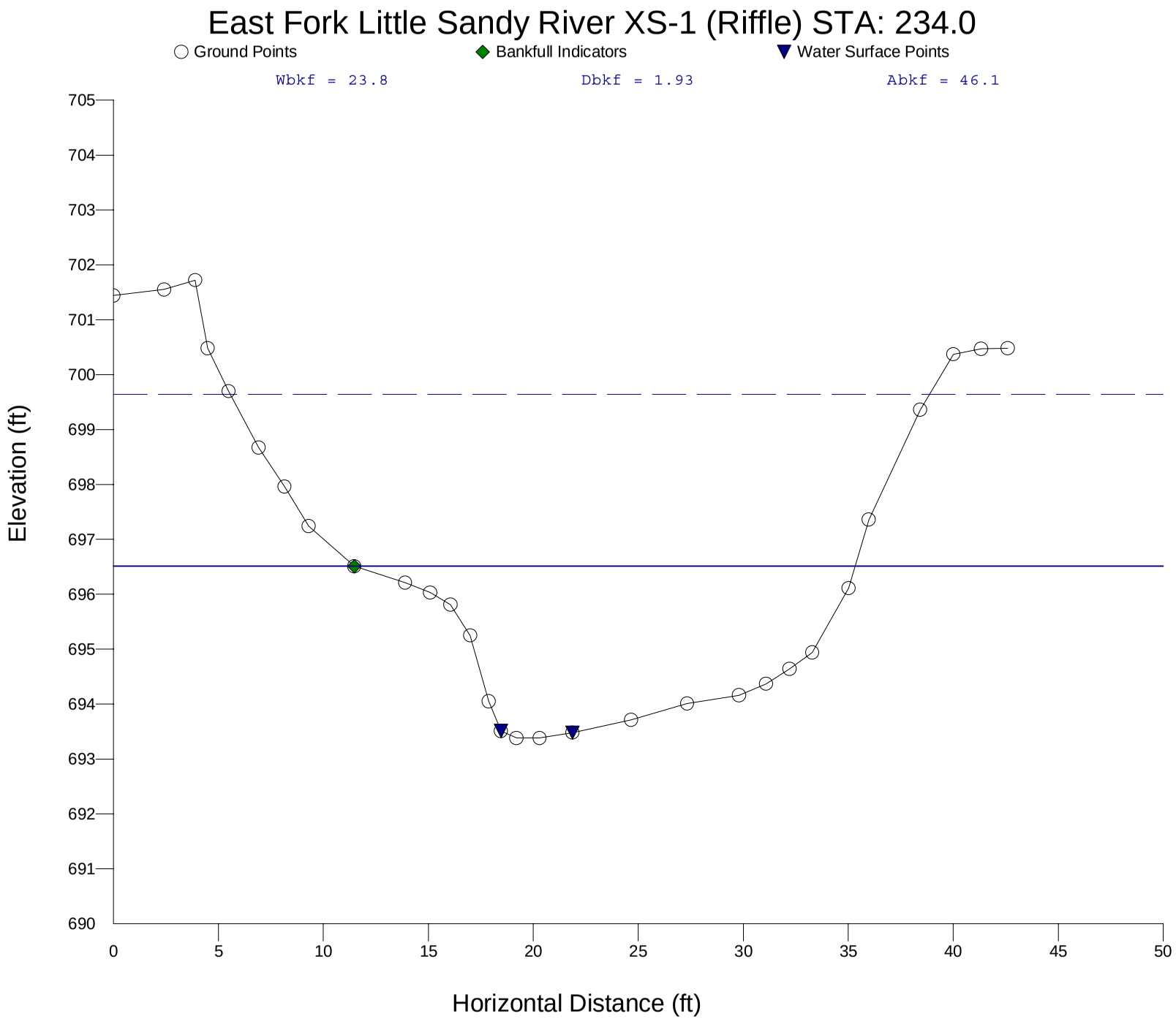
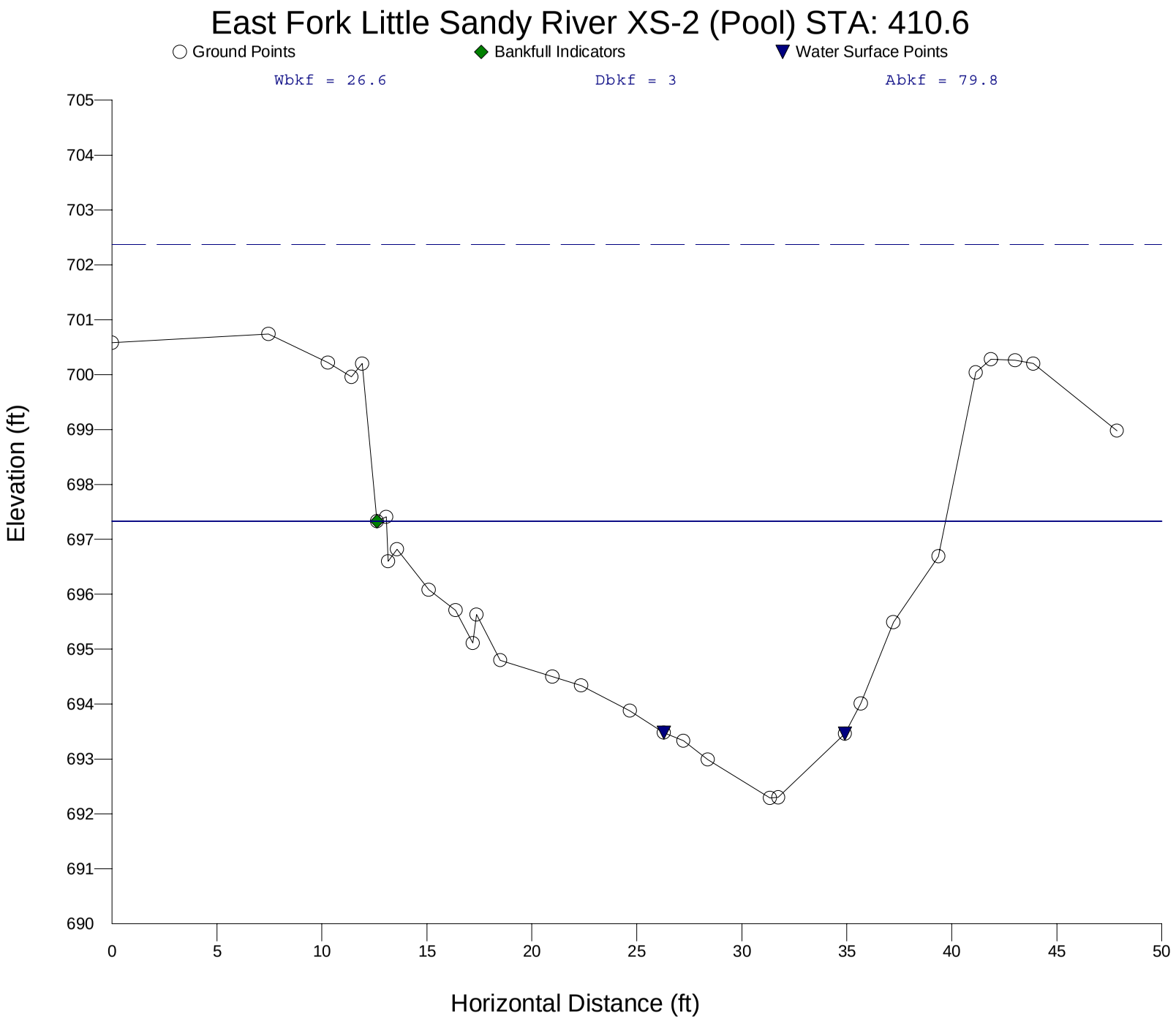
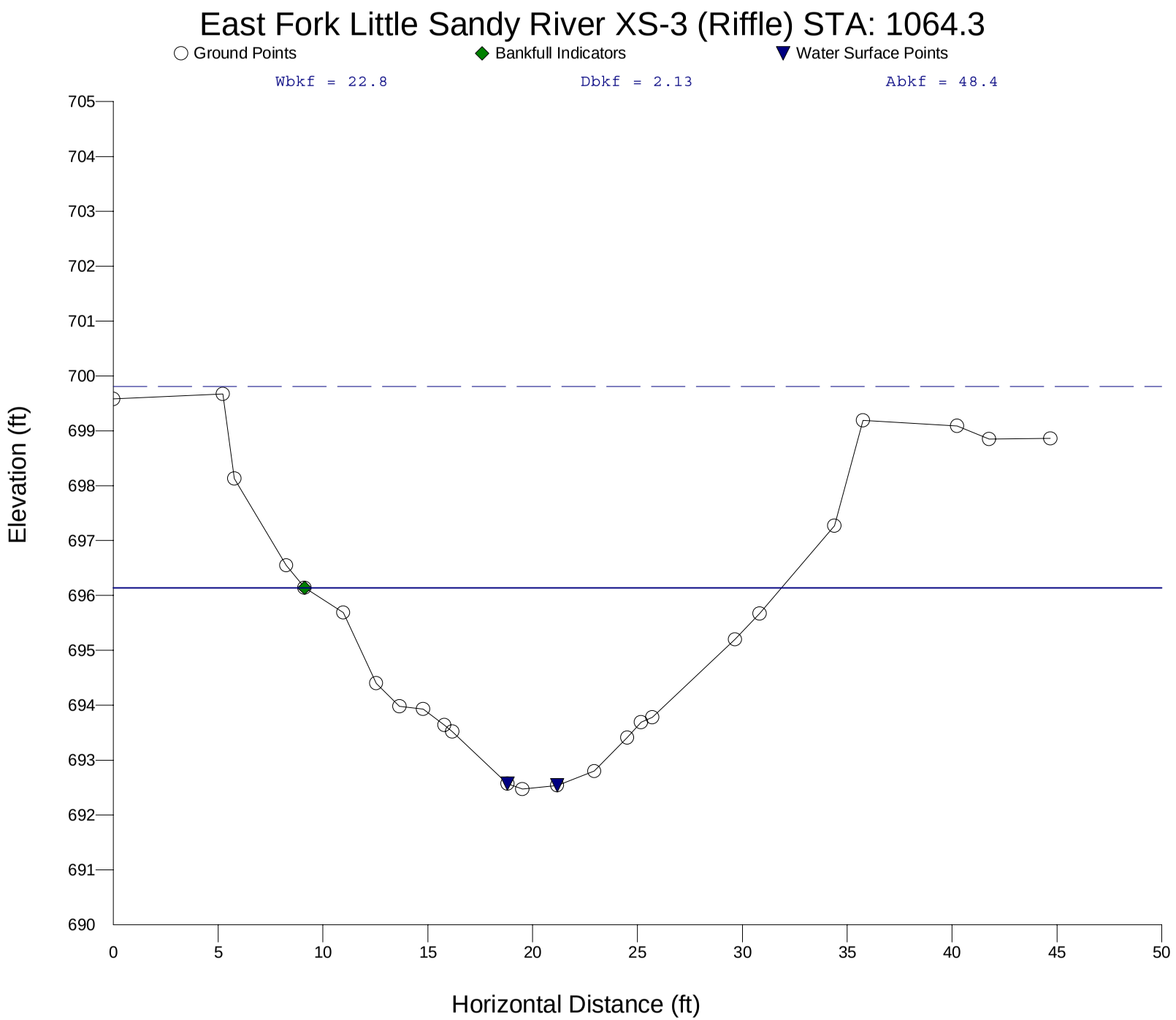
Appendix B – Existing Geomorphic Data


EFLS Longitudinal Profile
XS-1 Riffle 234
XS-2 Pool 410.6
XS-3 Riffle 1064.3
CH
WS
BKF
TOB
Elevation (ft)
Distance along stream (ft)
697
696
695
694
693
692
691
690
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100


East Fork Little Sandy River XS-1 (Riffle) STA: 234.0
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 23.8
Dbkf = 1.93
Abkf = 46.1
Elevation (ft)
705
704
703
702
701
700
699
698
697
696
695
694
693
692
691
690
0
5
10
15
20
25
30
35
40
45
50
Horizontal Distance (ft)


East Fork Little Sandy River XS-2 (Pool) STA: 410.6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 26.6
Dbkf = 3
Abkf = 79.8
Elevation (ft)
705
704
703
702
701
700
699
698
697
696
695
694
693
692
691
690
0
5
10
15
20
25
30
35
40
45
50
Horizontal Distance (ft)


East Fork Little Sandy River XS-3 (Riffle) STA: 1064.3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 22.8
Dbkf = 2.13
Abkf = 48.4
Elevation (ft)
705
704
703
702
701
700
699
698
697
696
695
694
693
692
691
690
0
5
10
15
20
25
30
35
40
45
50
Horizontal Distance (ft)

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Reach 1
Sample Name: Riffle XS1
Survey Date: 06/18/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	5	5.00	6.00
0.25 - 0.50	1	1.00	7.00
0.50 - 1.0	21	21.00	28.00
1.0 - 2.0	9	9.00	37.00
2.0 - 4.0	17	17.00	54.00
4.0 - 5.7	16	16.00	70.00
5.7 - 8.0	19	19.00	89.00
8.0 - 11.3	9	9.00	98.00
11.3 - 16.0	2	2.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.71
D35 (mm)	1.78
D50 (mm)	3.53
D84 (mm)	7.39
D95 (mm)	10.2
D100 (mm)	16
Silt/Clay (%)	1
Sand (%)	36
Gravel (%)	63
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Reach 1
Sample Name: Riffle XS-3
Survey Date: 08/14/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	1	1.00	2.00
0.50 - 1.0	14	14.00	16.00
1.0 - 2.0	2	2.00	18.00
2.0 - 4.0	15	15.00	33.00
4.0 - 5.7	18	18.00	51.00
5.7 - 8.0	12	12.00	63.00
8.0 - 11.3	19	19.00	82.00
11.3 - 16.0	6	6.00	88.00
16.0 - 22.6	6	6.00	94.00
22.6 - 32.0	0	0.00	94.00
32 - 45	4	4.00	98.00
45 - 64	2	2.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	1
D35 (mm)	4.19
D50 (mm)	5.61
D84 (mm)	12.87
D95 (mm)	35.25
D100 (mm)	64
Silt/Clay (%)	1
Sand (%)	17
Gravel (%)	82
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Reach 1
Sample Name: Reach Avg
Survey Date: 06/18/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	5	5.00	5.00
0.062 - 0.125	0	0.00	5.00
0.125 - 0.25	5	5.00	10.00
0.25 - 0.50	30	30.00	40.00
0.50 - 1.0	34	34.00	74.00
1.0 - 2.0	3	3.00	77.00
2.0 - 4.0	7	7.00	84.00
4.0 - 5.7	2	2.00	86.00
5.7 - 8.0	9	9.00	95.00
8.0 - 11.3	4	4.00	99.00
11.3 - 16.0	1	1.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.3
D35 (mm)	0.46
D50 (mm)	0.65
D84 (mm)	4
D95 (mm)	8
D100 (mm)	16
Silt/Clay (%)	5
Sand (%)	72
Gravel (%)	23
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Reach 1
Sample Name: Bar Sample 2
Survey Date: 08/18/2008

SIEVE (mm)	NET WT
16	8.59
8	104.23
4	607.44
2	835.35
0.85	1289.27
0.6	871.36
0.3	1531.57
0.15	382.66
0.075	35.89
PAN	26.53

D16 (mm)	0.39
D35 (mm)	0.61
D50 (mm)	0.86
D84 (mm)	3.61
D95 (mm)	7.07
D100 (mm)	32.09
Silt/Clay (%)	0
Sand (%)	72.27
Gravel (%)	27.73
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 5724.6200.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	32.09	17.27
Particle 2:	20.13	14.46

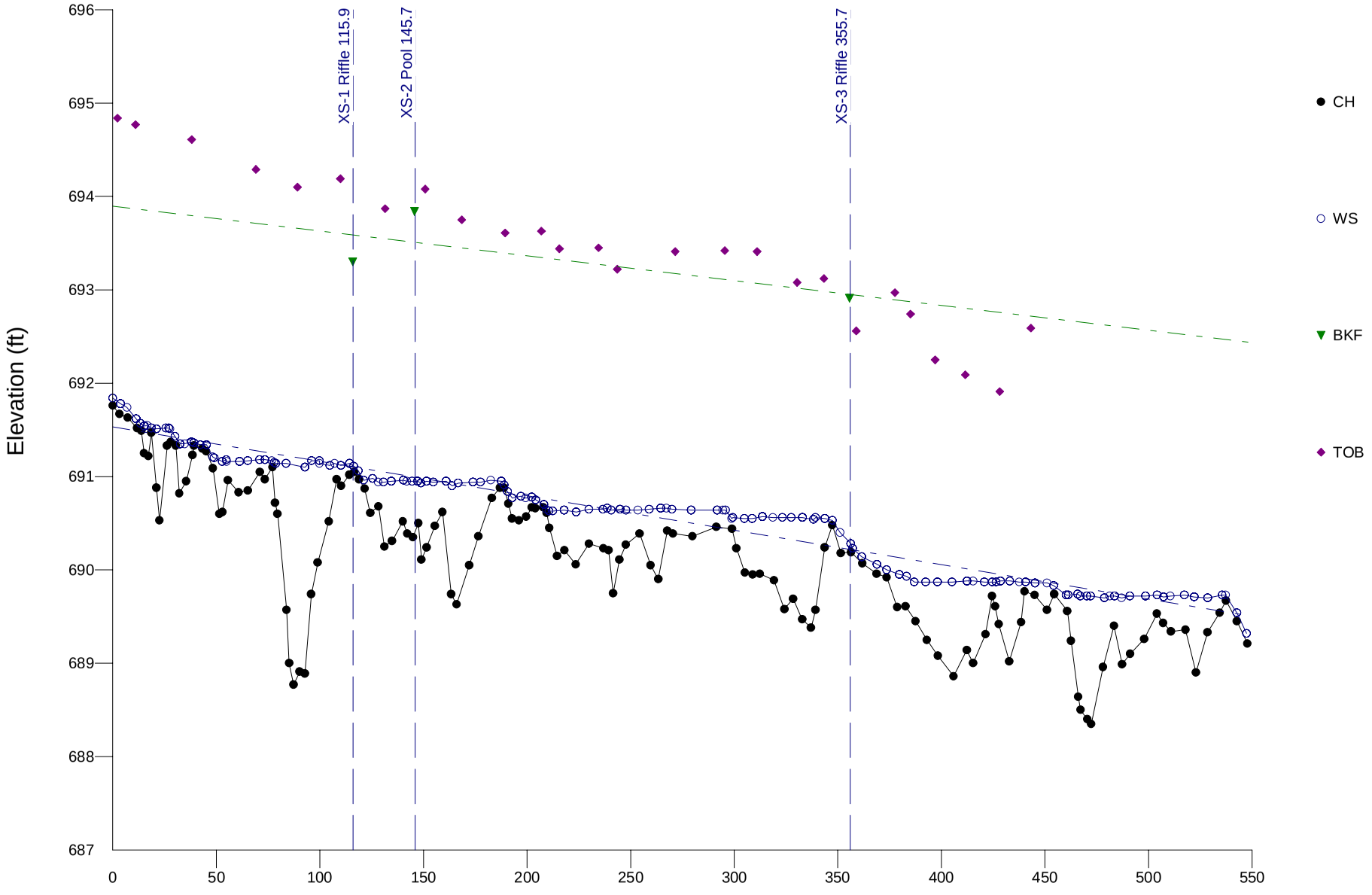
RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: EF Little Sandy River
Reach Name: Reach 1 <-- This is not a Reference Reach
Drainage Area: 7 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 07/14/2008

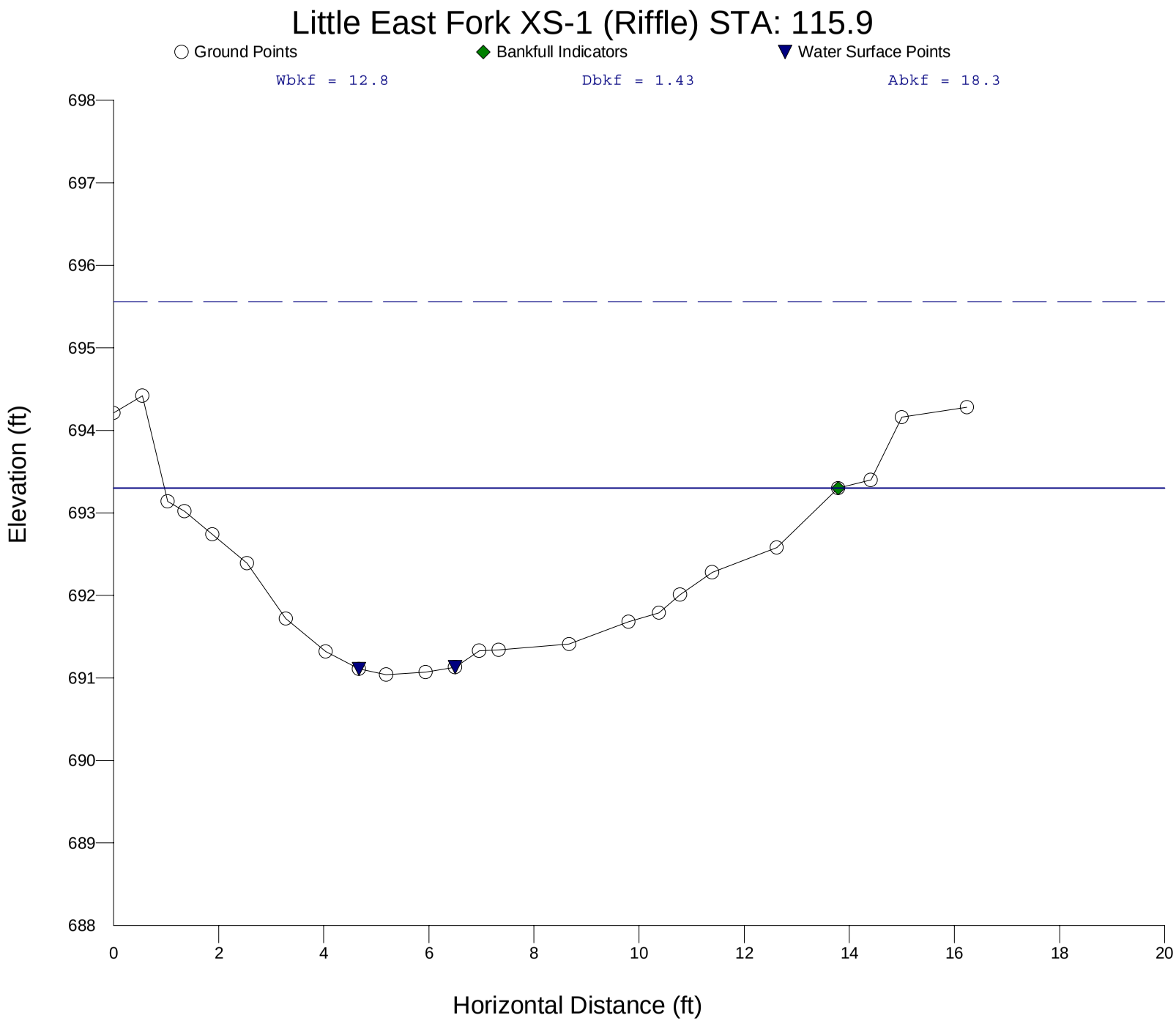
Classification Data

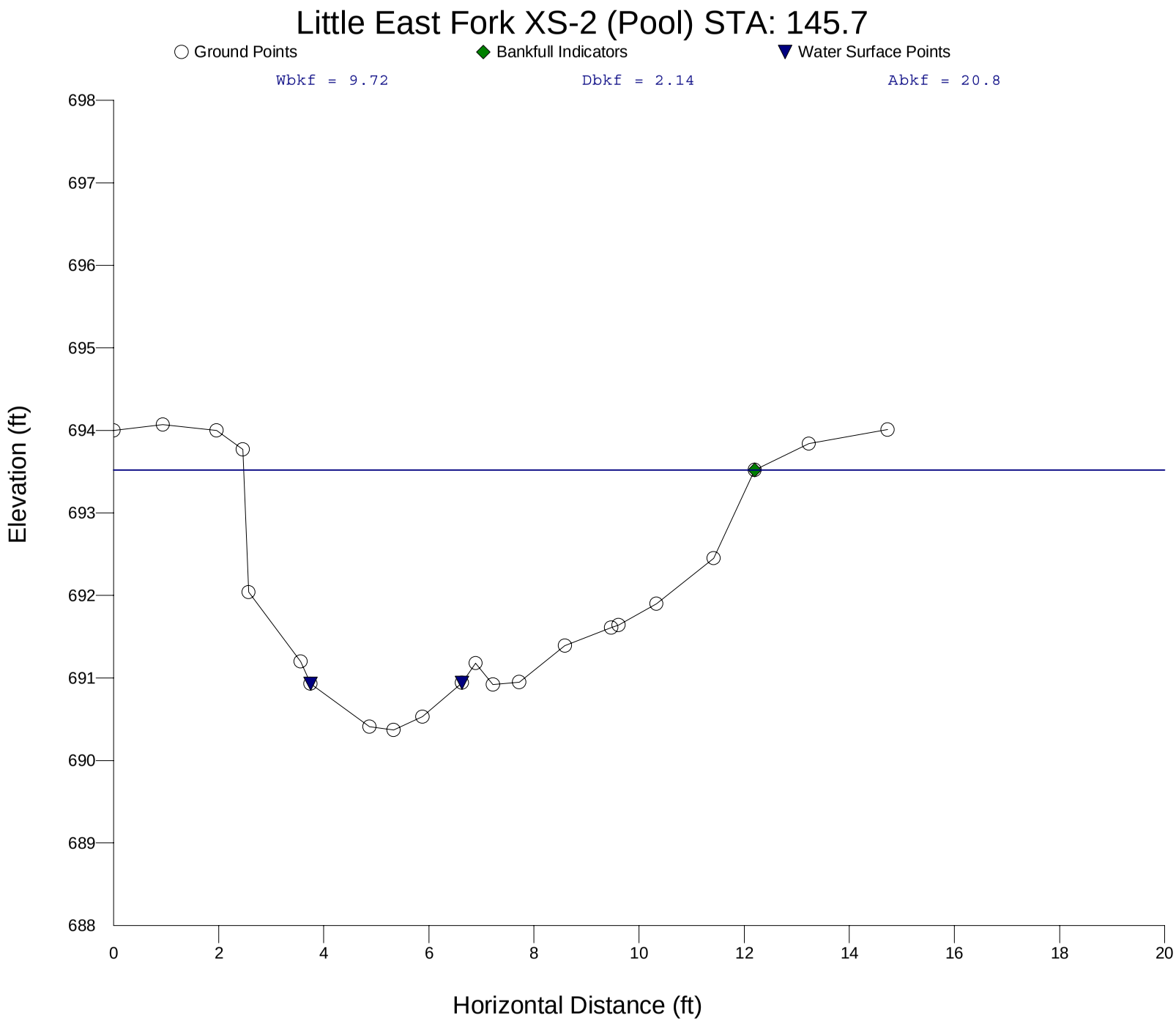
Valley Type:	Type VIII	
Valley Slope:	0.0022	ft/ft
Number of Channels:	Single	
Width:	22.76	ft
Mean Depth:	2.13	ft
Flood-Prone Width:	100	ft
Channel Materials D50:	0.65	mm
Water Surface Slope:	0.0018	ft/ft
Sinuosity:	1.1	
Discharge:	205	cfs
Velocity:	4.24	fps
Cross Sectional Area:	48.36	sq ft
Entrenchment Ratio:	4.39	
Width to Depth Ratio:	10.69	
Rosgen Stream Classification:	E 5	

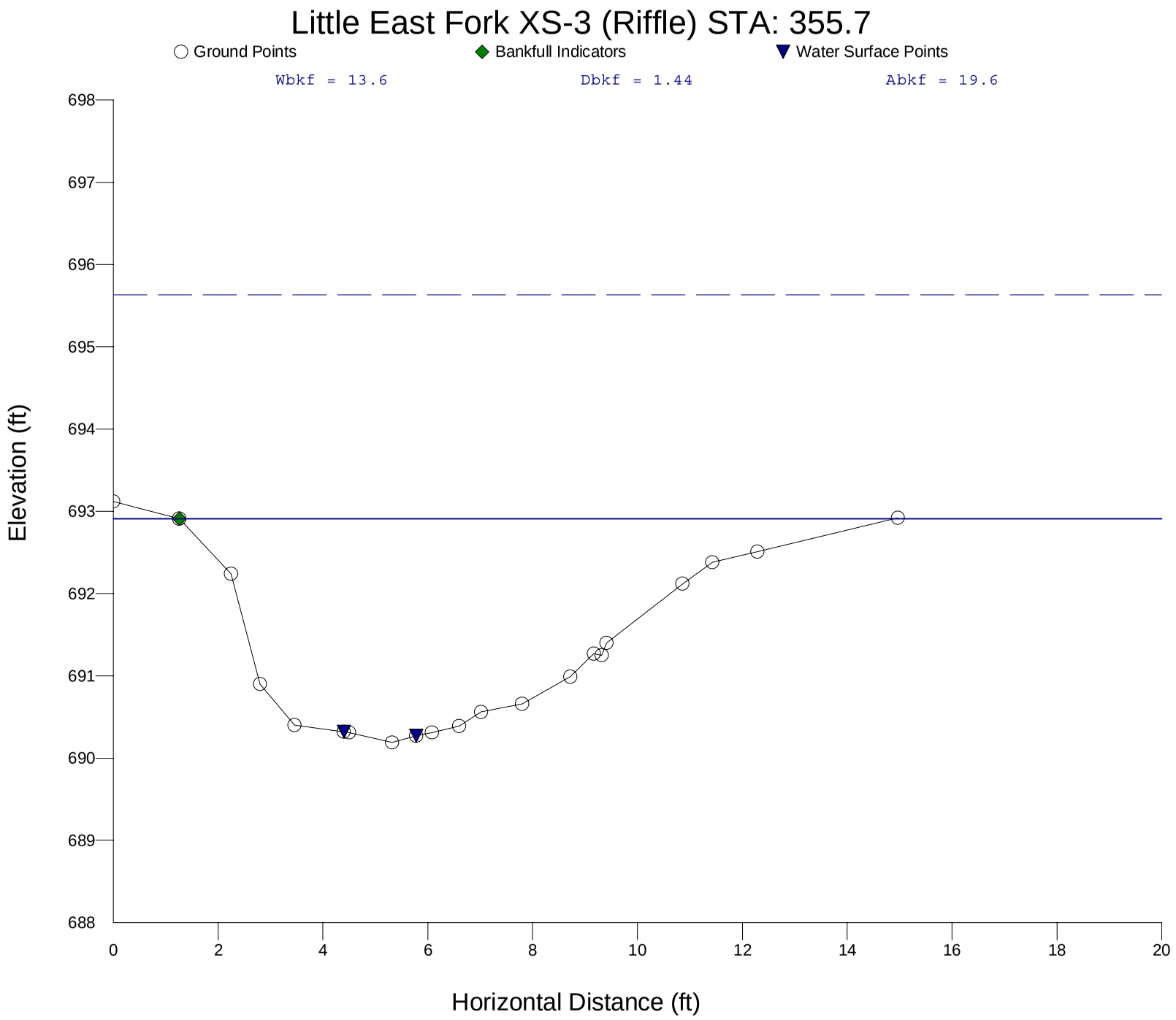
Little East Fork Longitudinal Profile

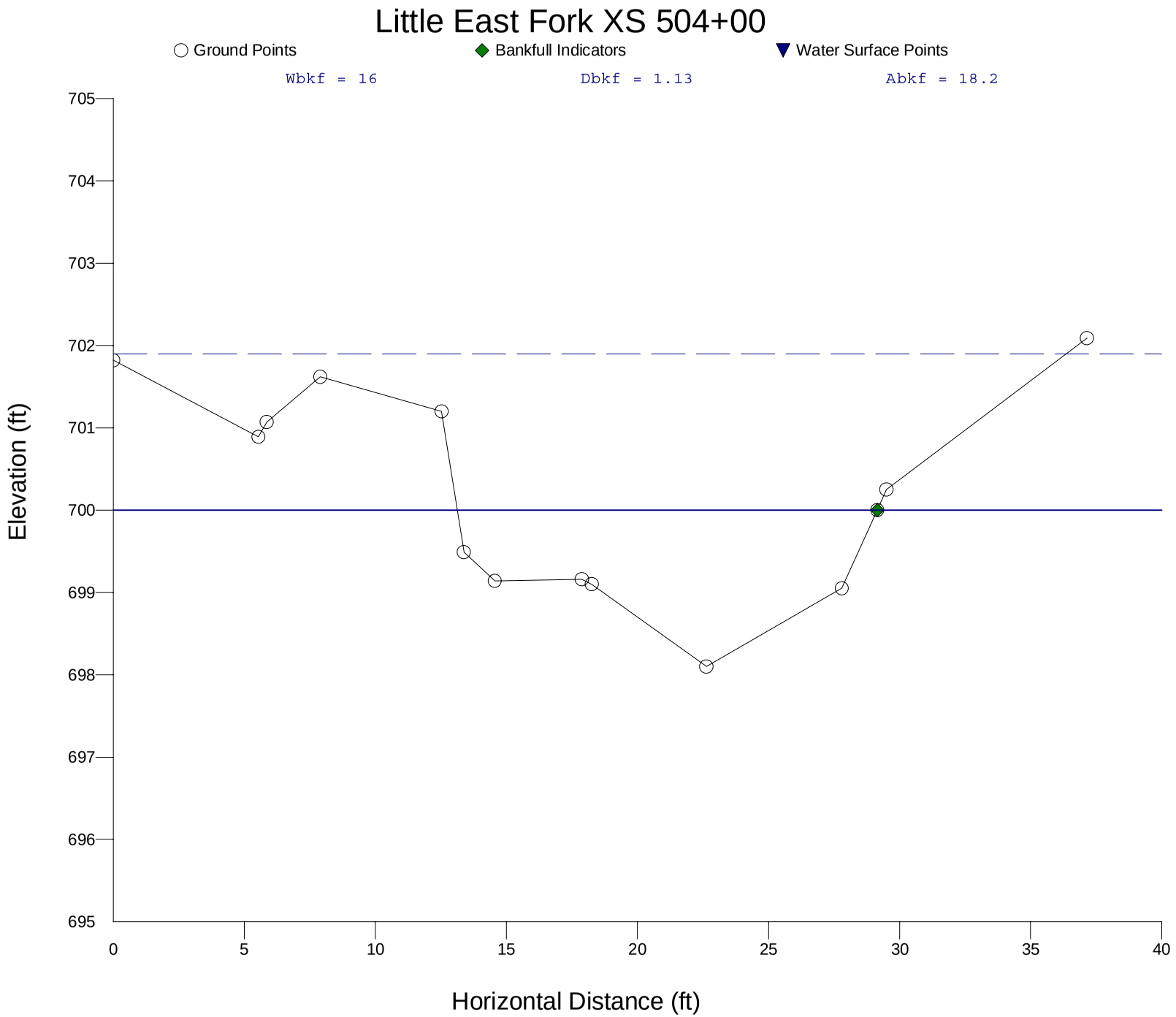


WS Best Fit Slope = 0.00367
BKF Best Fit Slope = 0.00266


Little East Fork XS-1 (Riffle) STA: 115.9
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 12.8
Dbkf = 1.43
Abkf = 18.3
698
697
696
695
694
693
692
691
690
689
688
Elevation (ft)
0
2
4
6
8
10
12
14
16
18
20
Horizontal Distance (ft)


Little East Fork XS-2 (Pool) STA: 145.7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.72
Dbkf = 2.14
Abkf = 20.8
Elevation (ft)
698
697
696
695
694
693
692
691
690
689
688
0
2
4
6
8
10
12
14
16
18
20
Horizontal Distance (ft)


Little East Fork XS-3 (Riffle) STA: 355.7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 13.6
Dbkf = 1.44
Abkf = 19.6
Elevation (ft)
698
697
696
695
694
693
692
691
690
689
688
0
2
4
6
8
10
12
14
16
18
20
Horizontal Distance (ft)


Little East Fork XS 504+00
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 16
Dbkf = 1.13
Abkf = 18.2
Elevation (ft)
705
704
703
702
701
700
699
698
697
696
695
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 1
Sample Name: Riffle XS3
Survey Date: 08/25/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	25	25.00	26.00
0.50 - 1.0	4	4.00	30.00
1.0 - 2.0	3	3.00	33.00
2.0 - 4.0	9	9.00	42.00
4.0 - 5.7	9	9.00	51.00
5.7 - 8.0	8	8.00	59.00
8.0 - 11.3	8	8.00	67.00
11.3 - 16.0	8	8.00	75.00
16.0 - 22.6	13	13.00	88.00
22.6 - 32.0	10	10.00	98.00
32 - 45	2	2.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.4
D35 (mm)	2.44
D50 (mm)	5.51
D84 (mm)	20.57
D95 (mm)	29.18
D100 (mm)	45
Silt/Clay (%)	1
Sand (%)	32
Gravel (%)	67
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 1
Sample Name: upstream reach
Survey Date: 09/11/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	1	0.89	0.89
0.50 - 1.0	3	2.68	3.57
1.0 - 2.0	2	1.79	5.36
2.0 - 4.0	3	2.68	8.04
4.0 - 5.7	3	2.68	10.71
5.7 - 8.0	4	3.57	14.29
8.0 - 11.3	8	7.14	21.43
11.3 - 16.0	14	12.50	33.93
16.0 - 22.6	17	15.18	49.11
22.6 - 32.0	18	16.07	65.18
32 - 45	24	21.43	86.61
45 - 64	13	11.61	98.21
64 - 90	2	1.79	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	8.79
D35 (mm)	16.47
D50 (mm)	23.12
D84 (mm)	43.42
D95 (mm)	58.74
D100 (mm)	90
Silt/Clay (%)	0
Sand (%)	5.36
Gravel (%)	92.85
Cobble (%)	1.79
Boulder (%)	0
Bedrock (%)	0

Total Particles = 112.

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 1
Sample Name: Bar Sample
Survey Date: 08/25/2008

SIEVE (mm)	NET WT
16	468.86
8	1742.72
4	1388.88
2	907.84
0.85	988.39
0.6	754.57
0.3	1138.74
0.15	268.02
0.075	76.63
PAN	53.66

D16 (mm)	0.53
D35 (mm)	1.38
D50 (mm)	3.42
D84 (mm)	12.66
D95 (mm)	18.12
D100 (mm)	33.57
Silt/Clay (%)	0
Sand (%)	41.79
Gravel (%)	58.21
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 7848.5200.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	24.19	38.99
Particle 2:	33.57	21.22

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Little East Fork
Reach Name: Reach 1 <-- This is not a Reference Reach
Drainage Area: 1.9 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 08/25/2008

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0031	ft/ft
Number of Channels:	Single	
Width:	16.02	ft
Mean Depth:	1.13	ft
Flood-Prone Width:	36.36	ft
Channel Materials D50:	2.83	mm
Water Surface Slope:	0.0026	ft/ft
Sinuosity:	1.18	
Discharge:	67	cfs
Velocity:	3.53	fps
Cross Sectional Area:	19	sq ft
Entrenchment Ratio:	2.27	
Width to Depth Ratio:	14.18	
Rosgen Stream Classification:	C 4	

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 2
Sample Name: Riffle XS1
Survey Date: 06/19/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	4.00	4.00
0.062 - 0.125	0	0.00	4.00
0.125 - 0.25	1	1.00	5.00
0.25 - 0.50	7	7.00	12.00
0.50 - 1.0	15	15.00	27.00
1.0 - 2.0	3	3.00	30.00
2.0 - 4.0	5	5.00	35.00
4.0 - 5.7	7	7.00	42.00
5.7 - 8.0	21	21.00	63.00
8.0 - 11.3	18	18.00	81.00
11.3 - 16.0	6	6.00	87.00
16.0 - 22.6	12	12.00	99.00
22.6 - 32.0	1	1.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.63
D35 (mm)	4
D50 (mm)	6.58
D84 (mm)	13.65
D95 (mm)	20.4
D100 (mm)	32
Silt/Clay (%)	4
Sand (%)	26
Gravel (%)	70
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 2
Sample Name: Riffle XS3
Survey Date: 06/19/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	25	25.00	26.00
0.50 - 1.0	4	4.00	30.00
1.0 - 2.0	3	3.00	33.00
2.0 - 4.0	9	9.00	42.00
4.0 - 5.7	9	9.00	51.00
5.7 - 8.0	8	8.00	59.00
8.0 - 11.3	8	8.00	67.00
11.3 - 16.0	8	8.00	75.00
16.0 - 22.6	13	13.00	88.00
22.6 - 32.0	10	10.00	98.00
32 - 45	2	2.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.4
D35 (mm)	2.44
D50 (mm)	5.51
D84 (mm)	20.57
D95 (mm)	29.18
D100 (mm)	45
Silt/Clay (%)	1
Sand (%)	32
Gravel (%)	67
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 2
Sample Name: Reach Avg
Survey Date: 06/19/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	8	7.92	7.92
0.062 - 0.125	0	0.00	7.92
0.125 - 0.25	7	6.93	14.85
0.25 - 0.50	23	22.77	37.62
0.50 - 1.0	9	8.91	46.53
1.0 - 2.0	1	0.99	47.52
2.0 - 4.0	6	5.94	53.47
4.0 - 5.7	12	11.88	65.35
5.7 - 8.0	8	7.92	73.27
8.0 - 11.3	9	8.91	82.18
11.3 - 16.0	1	0.99	83.17
16.0 - 22.6	9	8.91	92.08
22.6 - 32.0	4	3.96	96.04
32 - 45	4	3.96	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.26
D35 (mm)	0.47
D50 (mm)	2.83
D84 (mm)	16.61
D95 (mm)	29.53
D100 (mm)	45
Silt/Clay (%)	7.92
Sand (%)	39.6
Gravel (%)	52.48
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 101.

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 2
Sample Name: Bar Sample
Survey Date: 06/19/2008

SIEVE (mm)	NET WT
16	480.25
8	824.47
4	623.89
2	401.29
0.85	411.5
0.6	723.32
0.3	670.09
0.15	144.3
0.075	51.08
PAN	25.3

D16 (mm)	0.52
D35 (mm)	0.83
D50 (mm)	2.89
D84 (mm)	14.34
D95 (mm)	26.32
D100 (mm)	33.57
Silt/Clay (%)	0
Sand (%)	45.93
Gravel (%)	54.07
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 4409.9500.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	33.57	21.22
Particle 2:	24.97	33.24

RIVERMORPH PARTICLE SUMMARY

River Name: Little East Fork
Reach Name: Reach 2
Sample Name: Bar Sample 2
Survey Date: 08/18/2008

SIEVE (mm)	NET WT
16	468.86
8	1742.72
4	1388.88
2	907.84
0.85	988.39
0.6	754.57
0.3	1138.74
0.15	268.02
0.075	76.63
PAN	53.66

D16 (mm)	0.53
D35 (mm)	1.38
D50 (mm)	3.42
D84 (mm)	12.66
D95 (mm)	18.12
D100 (mm)	33.57
Silt/Clay (%)	0
Sand (%)	41.79
Gravel (%)	58.21
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 7848.5200.

Largest Surface Particles:

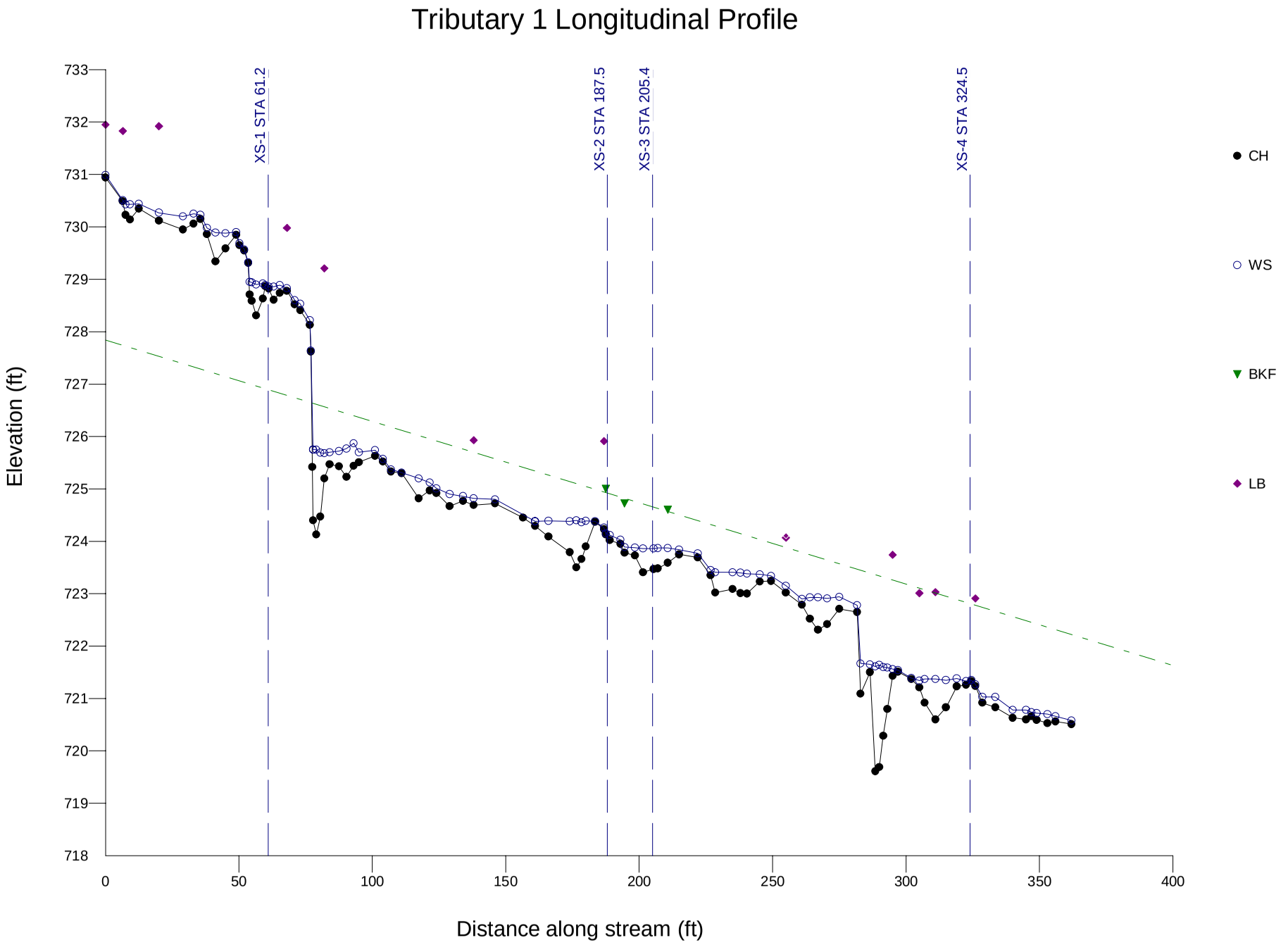
	Size(mm)	Weight
Particle 1:	24.19	38.99
Particle 2:	33.57	21.22

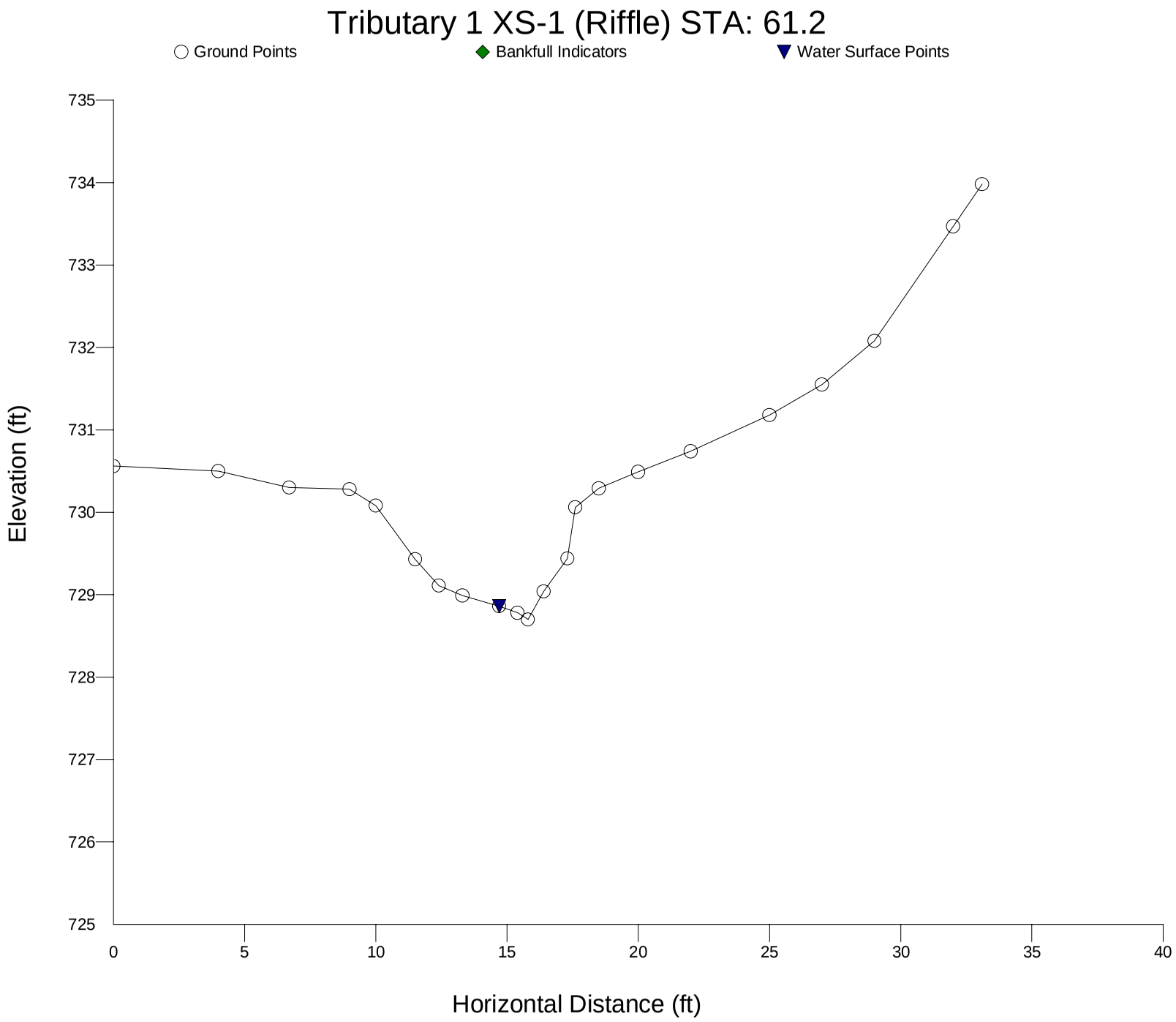
RIVERMORPH STREAM CHANNEL CLASSIFICATION

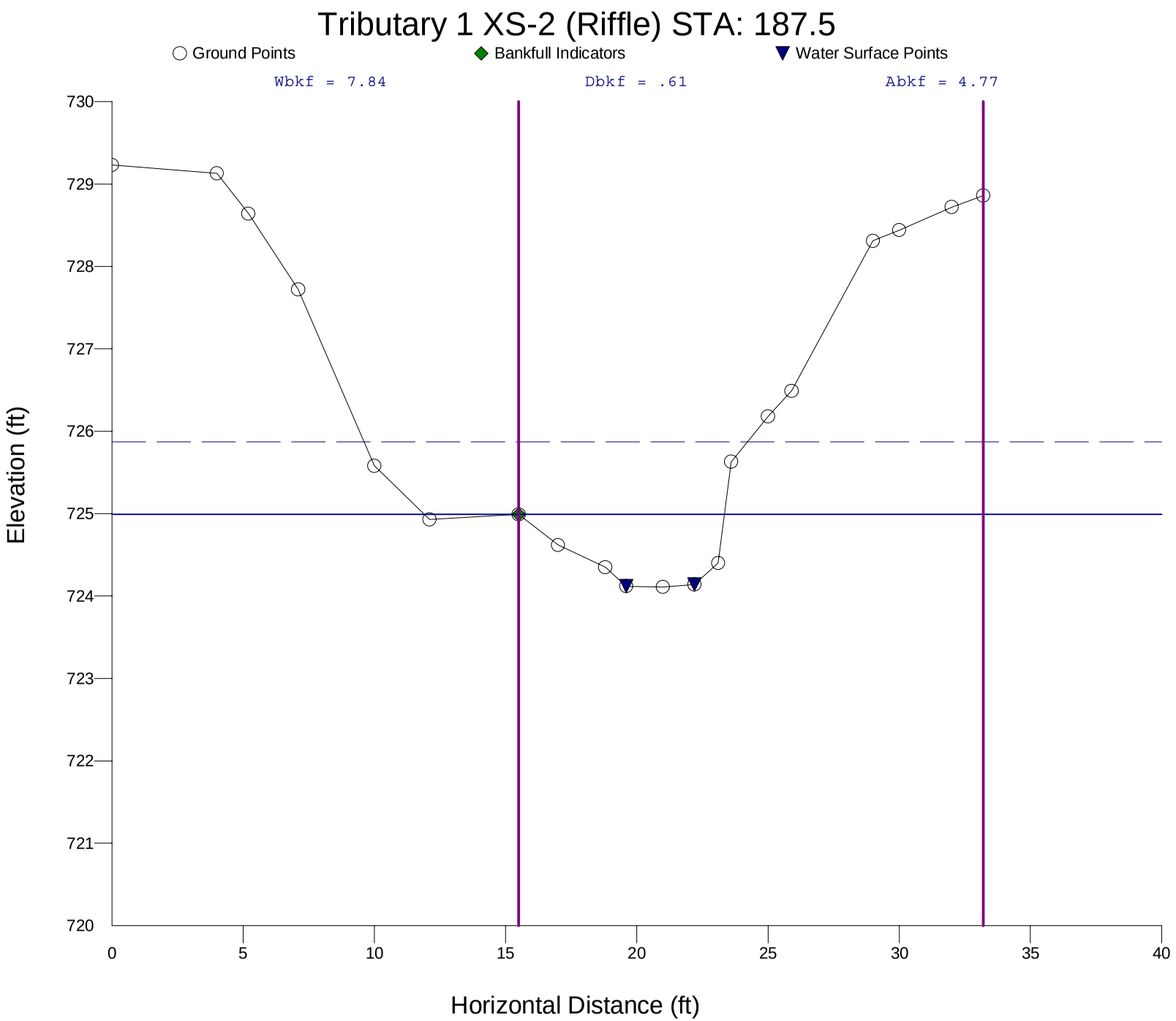
River Name: Little East Fork
Reach Name: Reach 2 <-- This is not a Reference Reach
Drainage Area: 2.15 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 07/14/2008

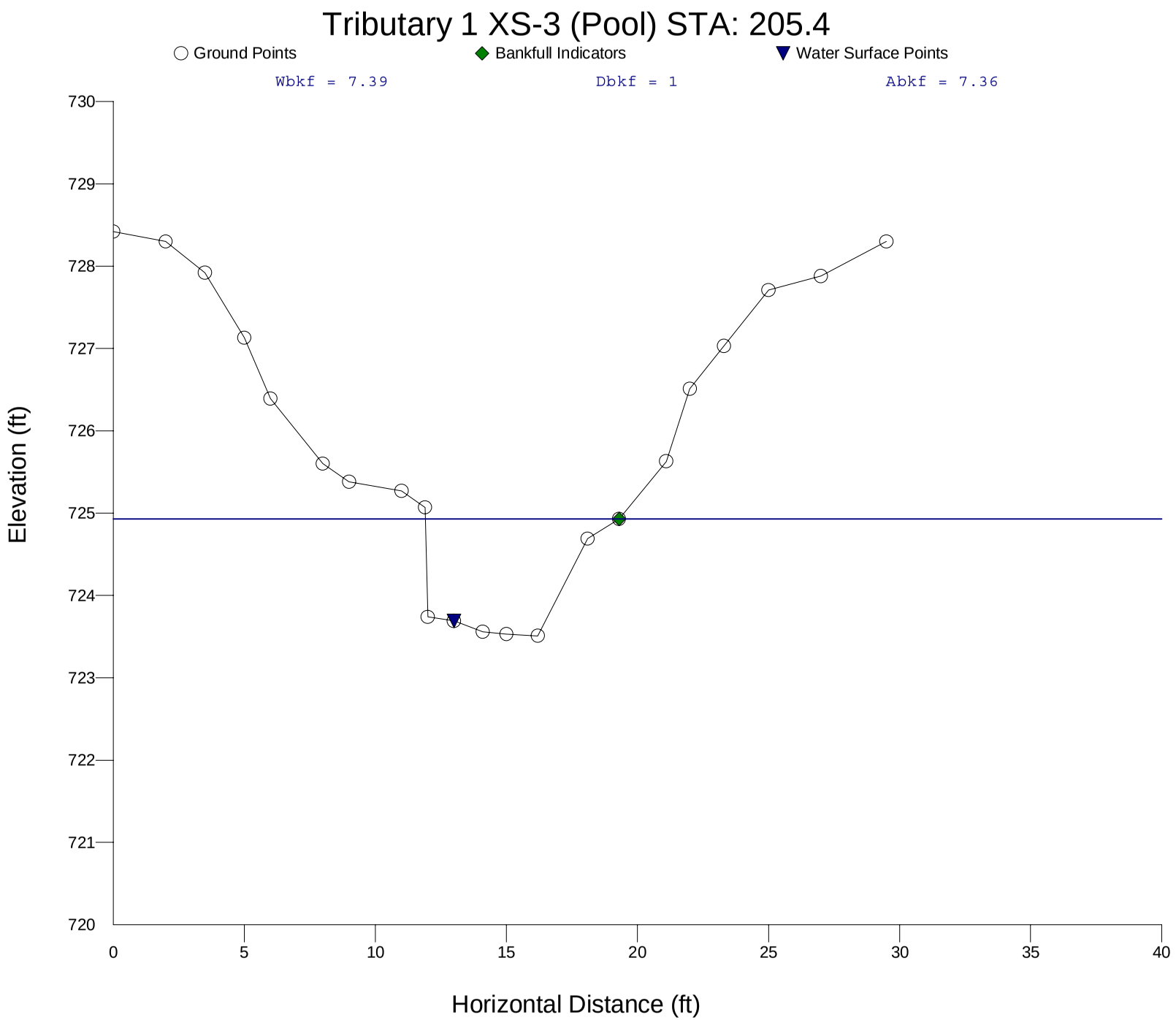
Classification Data

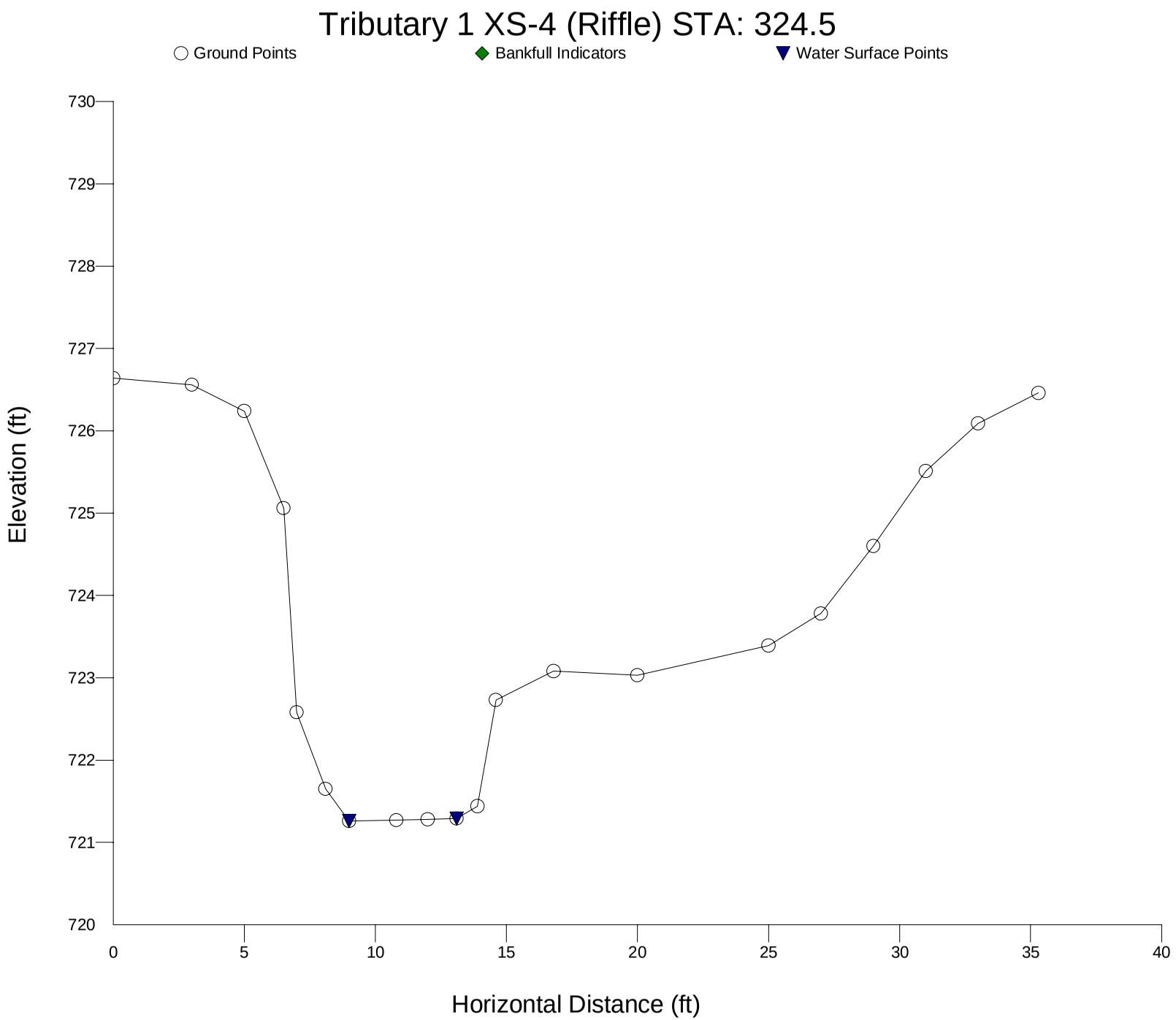
Valley Type:	Type VIII	
Valley Slope:	0.005	ft/ft
Number of Channels:	Single	
Width:	12.82	ft
Mean Depth:	1.43	ft
Flood-Prone Width:	150	ft
Channel Materials D50:	2.83	mm
Water Surface Slope:	0.004	ft/ft
Sinuosity:	1.18	
Discharge:	85.24	cfs
Velocity:	4.65	fps
Cross Sectional Area:	18.35	sq ft
Entrenchment Ratio:	11.7	
Width to Depth Ratio:	8.97	
Rosgen Stream Classification:	E 4	

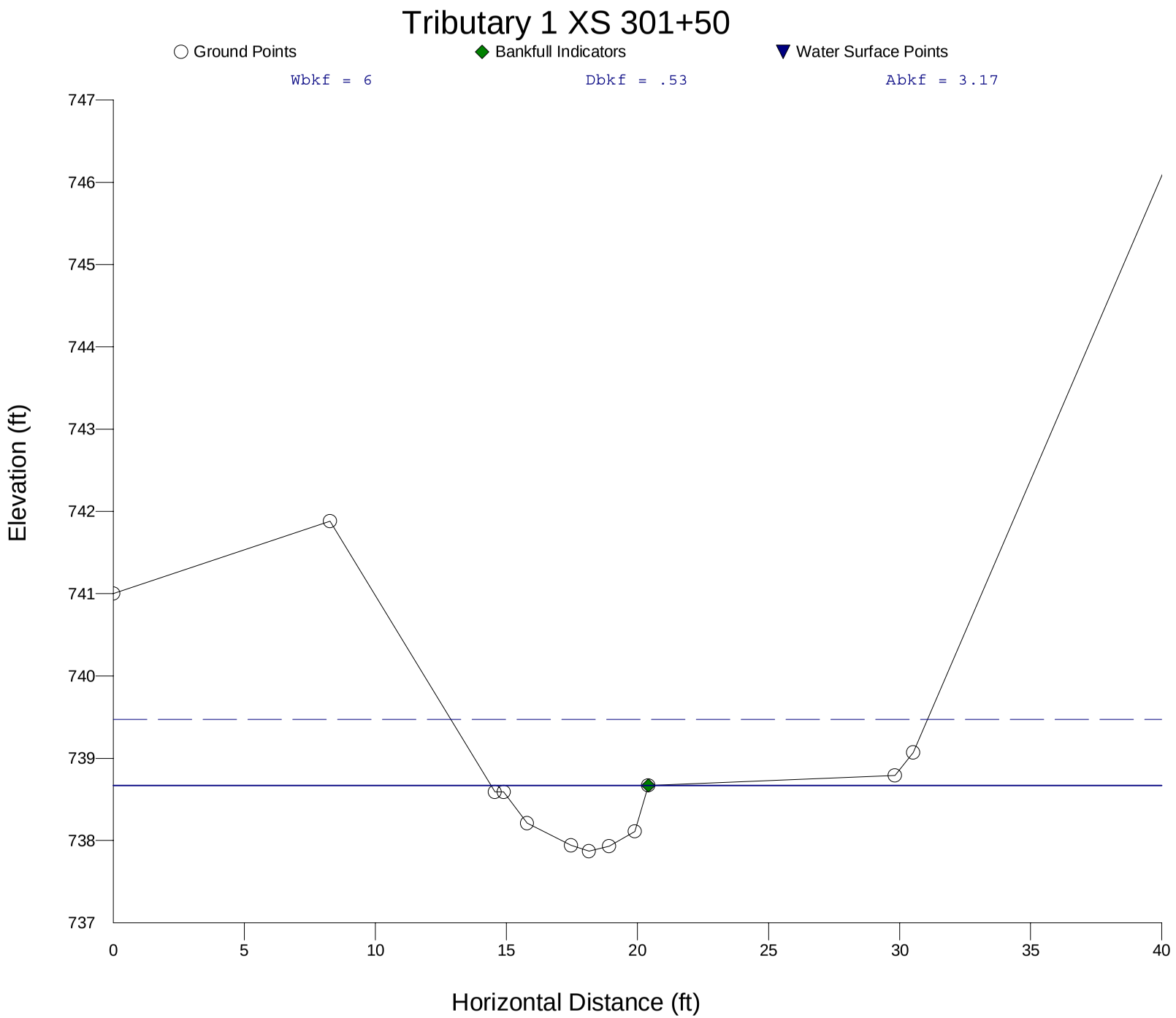

Tributary 1 Longitudinal Profile
XS-1 STA 61.2
XS-2 STA 187.5
XS-3 STA 205.4
XS-4 STA 324.5
CH
WS
BKF
LB
Elevation (ft)
Distance along stream (ft)
733
732
731
730
729
728
727
726
725
724
723
722
721
720
719
718
0
50
100
150
200
250
300
350
400

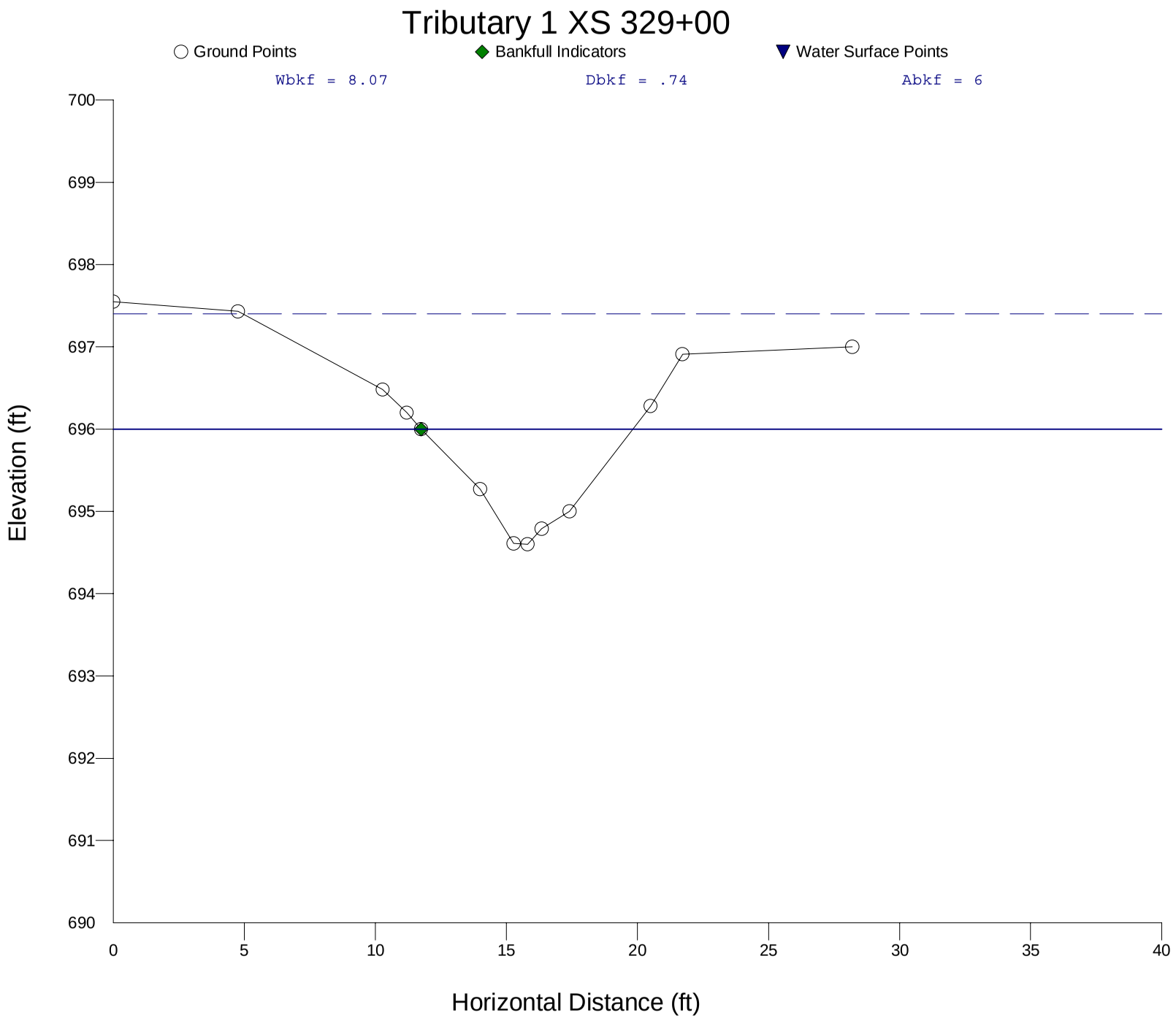

Tributary 1 XS-1 (Riffle) STA: 61.2
Ground Points
Bankfull Indicators
Water Surface Points
Elevation (ft)
735
734
733
732
731
730
729
728
727
726
725
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)


Tributary 1 XS-2 (Riffle) STA: 187.5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.84
Dbkf = .61
Abkf = 4.77
Elevation (ft)
730
729
728
727
726
725
724
723
722
721
720
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)


Tributary 1 XS-3 (Pool) STA: 205.4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.39
Dbkf = 1
Abkf = 7.36
Elevation (ft)
730
729
728
727
726
725
724
723
722
721
720
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)


Tributary 1 XS-4 (Riffle) STA: 324.5
Ground Points
Bankfull Indicators
Water Surface Points
Elevation (ft)
730
729
728
727
726
725
724
723
722
721
720
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)


Tributary 1 XS 301+50
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6
Dbkf = .53
Abkf = 3.17
747
746
745
744
743
742
741
740
739
738
737
Elevation (ft)
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)


Tributary 1 XS 329+00
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.07
Dbkf = .74
Abkf = 6
700
699
698
697
696
695
694
693
692
691
690
Elevation (ft)
0
5
10
15
20
25
30
35
40
Horizontal Distance (ft)

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 1
Sample Name: XS-2
Survey Date: 08/21/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	0	0.00	1.00
0.50 - 1.0	7	7.00	8.00
1.0 - 2.0	1	1.00	9.00
2.0 - 4.0	3	3.00	12.00
4.0 - 5.7	3	3.00	15.00
5.7 - 8.0	8	8.00	23.00
8.0 - 11.3	8	8.00	31.00
11.3 - 16.0	15	15.00	46.00
16.0 - 22.6	22	22.00	68.00
22.6 - 32.0	10	10.00	78.00
32 - 45	12	12.00	90.00
45 - 64	8	8.00	98.00
64 - 90	1	1.00	99.00
90 - 128	1	1.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	5.99
D35 (mm)	12.55
D50 (mm)	17.2
D84 (mm)	38.5
D95 (mm)	56.88
D100 (mm)	128
Silt/Clay (%)	1
Sand (%)	8
Gravel (%)	89
Cobble (%)	2
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 1
Sample Name: Reach Avg
Survey Date: 08/21/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	4	4.00	4.00
0.50 - 1.0	13	13.00	17.00
1.0 - 2.0	2	2.00	19.00
2.0 - 4.0	7	7.00	26.00
4.0 - 5.7	6	6.00	32.00
5.7 - 8.0	8	8.00	40.00
8.0 - 11.3	8	8.00	48.00
11.3 - 16.0	12	12.00	60.00
16.0 - 22.6	12	12.00	72.00
22.6 - 32.0	7	7.00	79.00
32 - 45	11	11.00	90.00
45 - 64	6	6.00	96.00
64 - 90	2	2.00	98.00
90 - 128	1	1.00	99.00
128 - 180	1	1.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.96
D35 (mm)	6.56
D50 (mm)	12.08
D84 (mm)	37.91
D95 (mm)	60.83
D100 (mm)	179.99
Silt/Clay (%)	0
Sand (%)	19
Gravel (%)	77
Cobble (%)	4
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 1
Sample Name: Bar Sample
Survey Date: 08/21/2008

SIEVE (mm)	NET WT
31.5	191
16	1642
8	1524
4	1325.57
2	886.9
0.85	851.04
0.6	273.29
0.3	372.48
0.15	165.33
0.075	81.38
PAN	70.79

D16 (mm)	1.17
D35 (mm)	3.83
D50 (mm)	7.16
D84 (mm)	23.05
D95 (mm)	30.84
D100 (mm)	51
Silt/Clay (%)	0
Sand (%)	24.2
Gravel (%)	75.8
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 7497.7800.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	51	57
Particle 2:	51	57

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Trib-1
Reach Name: Reach 1 <-- This is not a Reference Reach
Drainage Area: 0.152 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 08/21/2008

Classification Data

Valley Type:	Type II	
Valley Slope:	0.028	ft/ft
Number of Channels:	Single	
Width:	6	ft
Mean Depth:	0.53	ft
Flood-Prone Width:	18.18	ft
Channel Materials D50:	12.08	mm
Water Surface Slope:	0.025	ft/ft
Sinuosity:	1.14	
Discharge:	12.59	cfs
Velocity:	3.97	fps
Cross Sectional Area:	3.17	sq ft
Entrenchment Ratio:	3.03	
Width to Depth Ratio:	11.32	
Rosgen Stream Classification:	B4	

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 2
Sample Name: XS-2
Survey Date: 06/11/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	0	0.00	1.00
0.50 - 1.0	7	7.00	8.00
1.0 - 2.0	1	1.00	9.00
2.0 - 4.0	3	3.00	12.00
4.0 - 5.7	3	3.00	15.00
5.7 - 8.0	8	8.00	23.00
8.0 - 11.3	8	8.00	31.00
11.3 - 16.0	15	15.00	46.00
16.0 - 22.6	22	22.00	68.00
22.6 - 32.0	10	10.00	78.00
32 - 45	12	12.00	90.00
45 - 64	8	8.00	98.00
64 - 90	1	1.00	99.00
90 - 128	1	1.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	5.99
D35 (mm)	12.55
D50 (mm)	17.2
D84 (mm)	38.5
D95 (mm)	56.88
D100 (mm)	128
Silt/Clay (%)	1
Sand (%)	8
Gravel (%)	89
Cobble (%)	2
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 2
Sample Name: XS-4
Survey Date: 06/11/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	2	2.00	2.00
0.50 - 1.0	10	10.00	12.00
1.0 - 2.0	5	5.00	17.00
2.0 - 4.0	4	4.00	21.00
4.0 - 5.7	6	6.00	27.00
5.7 - 8.0	13	13.00	40.00
8.0 - 11.3	8	8.00	48.00
11.3 - 16.0	9	9.00	57.00
16.0 - 22.6	17	17.00	74.00
22.6 - 32.0	11	11.00	85.00
32 - 45	10	10.00	95.00
45 - 64	5	5.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	1.8
D35 (mm)	7.12
D50 (mm)	12.34
D84 (mm)	31.15
D95 (mm)	45
D100 (mm)	64
Silt/Clay (%)	0
Sand (%)	17
Gravel (%)	83
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 2
Sample Name: Reach Avg
Survey Date: 06/11/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	4	4.00	4.00
0.50 - 1.0	13	13.00	17.00
1.0 - 2.0	2	2.00	19.00
2.0 - 4.0	7	7.00	26.00
4.0 - 5.7	6	6.00	32.00
5.7 - 8.0	8	8.00	40.00
8.0 - 11.3	8	8.00	48.00
11.3 - 16.0	12	12.00	60.00
16.0 - 22.6	12	12.00	72.00
22.6 - 32.0	7	7.00	79.00
32 - 45	11	11.00	90.00
45 - 64	6	6.00	96.00
64 - 90	2	2.00	98.00
90 - 128	1	1.00	99.00
128 - 180	1	1.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.96
D35 (mm)	6.56
D50 (mm)	12.08
D84 (mm)	37.91
D95 (mm)	60.83
D100 (mm)	179.99
Silt/Clay (%)	0
Sand (%)	19
Gravel (%)	77
Cobble (%)	4
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 2
Sample Name: Bar Sample
Survey Date: 06/11/2008

SIEVE (mm)	NET WT
31.5	191
16	1642
8	1524
4	1325.57
2	886.9
0.85	851.04
0.6	273.29
0.3	372.48
0.15	165.33
0.075	81.38
PAN	70.79

D16 (mm)	1.17
D35 (mm)	3.83
D50 (mm)	7.16
D84 (mm)	23.05
D95 (mm)	30.84
D100 (mm)	51
Silt/Clay (%)	0
Sand (%)	24.2
Gravel (%)	75.8
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 7497.7800.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	51	57
Particle 2:	51	57

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Trib-1
Reach Name: Reach 2 <-- This is not a Reference Reach
Drainage Area: 0.219 sq mi
State: Kentucky
County: Lawrence
Latitude: 38.22333
Longitude: 82.75139
Survey Date: 08/07/2008

Classification Data

Valley Type:	Type II
Valley Slope:	0.0203 ft/ft
Number of Channels:	Single
Width:	7.84 ft
Mean Depth:	0.61 ft
Flood-Prone Width:	14.6 ft
Channel Materials D50:	12.08 mm
Water Surface Slope:	0.016 ft/ft
Sinuosity:	1.27
Discharge:	17.25 cfs
Velocity:	3.62 fps
Cross Sectional Area:	4.77 sq ft
Entrenchment Ratio:	1.86
Width to Depth Ratio:	12.85
Rosgen Stream Classification:	B 4c

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 3
Sample Name: XS-4
Survey Date: 08/25/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	2	2.00	2.00
0.50 - 1.0	10	10.00	12.00
1.0 - 2.0	5	5.00	17.00
2.0 - 4.0	4	4.00	21.00
4.0 - 5.7	6	6.00	27.00
5.7 - 8.0	13	13.00	40.00
8.0 - 11.3	8	8.00	48.00
11.3 - 16.0	9	9.00	57.00
16.0 - 22.6	17	17.00	74.00
22.6 - 32.0	11	11.00	85.00
32 - 45	10	10.00	95.00
45 - 64	5	5.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	1.8
D35 (mm)	7.12
D50 (mm)	12.34
D84 (mm)	31.15
D95 (mm)	45
D100 (mm)	64
Silt/Clay (%)	0
Sand (%)	17
Gravel (%)	83
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 3
Sample Name: Reach 3
Survey Date: 09/11/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	21	18.42	18.42
0.062 - 0.125	0	0.00	18.42
0.125 - 0.25	1	0.88	19.30
0.25 - 0.50	0	0.00	19.30
0.50 - 1.0	0	0.00	19.30
1.0 - 2.0	0	0.00	19.30
2.0 - 4.0	7	6.14	25.44
4.0 - 5.7	7	6.14	31.58
5.7 - 8.0	32	28.07	59.65
8.0 - 11.3	21	18.42	78.07
11.3 - 16.0	20	17.54	95.61
16.0 - 22.6	4	3.51	99.12
22.6 - 32.0	1	0.88	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.05
D35 (mm)	5.98
D50 (mm)	7.21
D84 (mm)	12.89
D95 (mm)	15.84
D100 (mm)	32
Silt/Clay (%)	18.42
Sand (%)	0.88
Gravel (%)	80.7
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 114.

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-1
Reach Name: Reach 3
Sample Name: Bar Sample
Survey Date: 08/21/2008

SIEVE (mm)	NET WT
31.5	191
16	1642
8	1524
4	1325.57
2	886.9
0.85	851.04
0.6	273.29
0.3	372.48
0.15	165.33
0.075	81.38
PAN	70.72

D16 (mm)	1.17
D35 (mm)	3.83
D50 (mm)	7.16
D84 (mm)	23.05
D95 (mm)	30.84
D100 (mm)	51
Silt/Clay (%)	0
Sand (%)	24.2
Gravel (%)	75.8
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 7497.7100.

Largest Surface Particles:

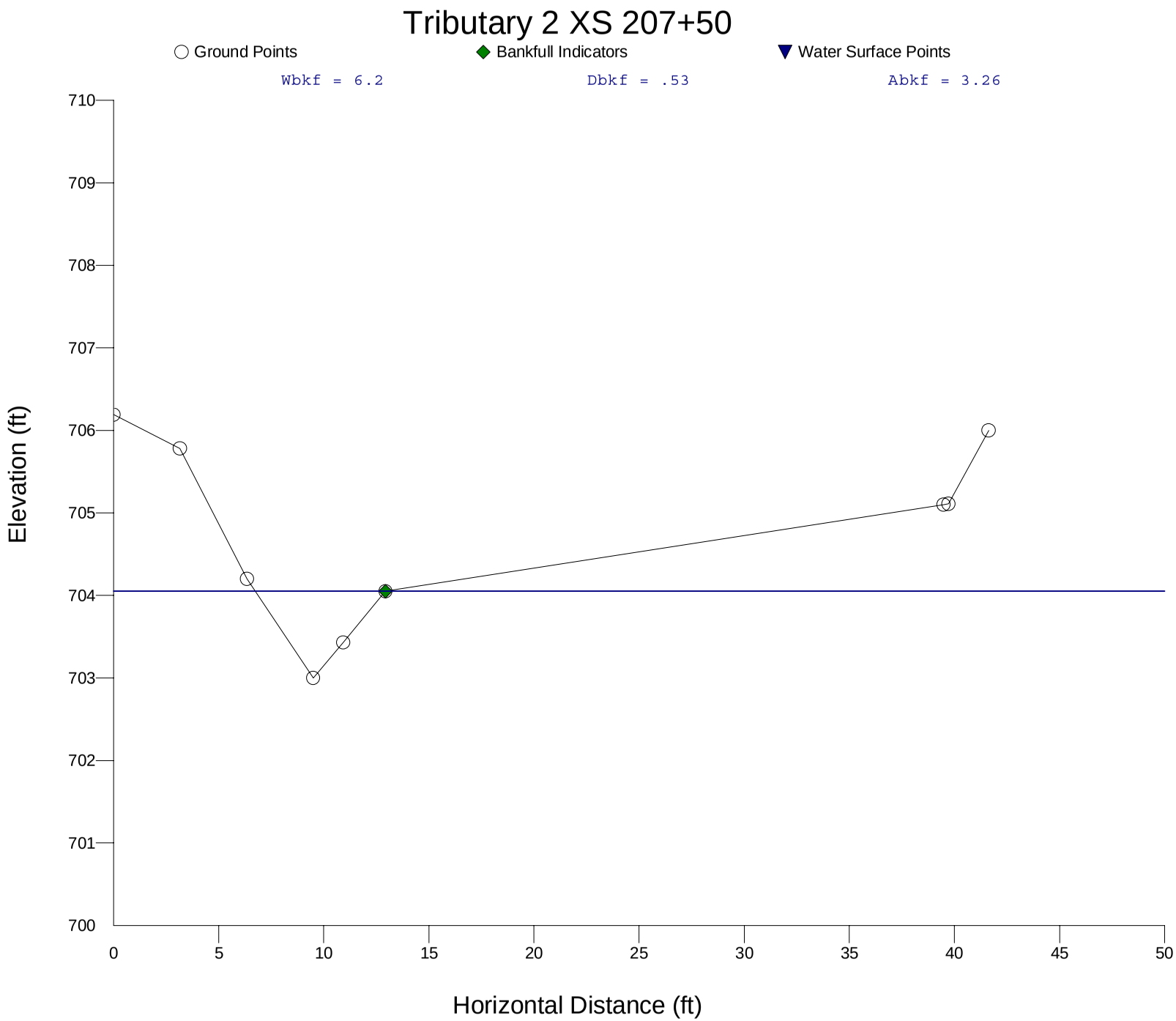
	Size(mm)	Weight
Particle 1:	51	57
Particle 2:	51	57

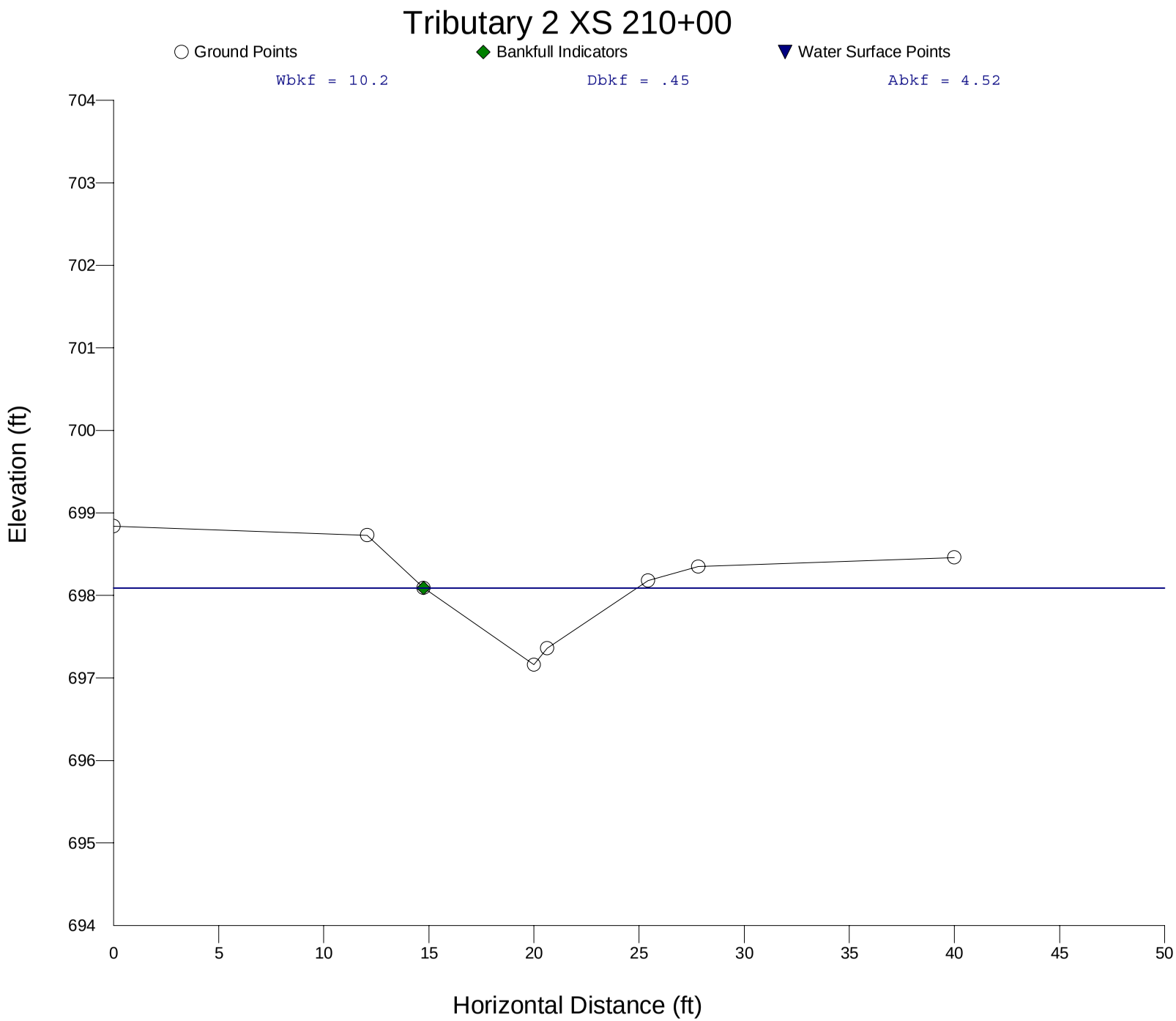
RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Trib-1
Reach Name: Reach 3 <-- This is not a Reference Reach
Drainage Area: 0.3 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 08/25/2008

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.008	ft/ft
Number of Channels:	Single	
Width:	8.07	ft
Mean Depth:	0.74	ft
Flood-Prone Width:	37	ft
Channel Materials D50:	7	mm
Water Surface Slope:	0.0075	ft/ft
Sinuosity:	1.05	
Discharge:	24.25	cfs
Velocity:	4.04	fps
Cross Sectional Area:	6	sq ft
Entrenchment Ratio:	4.58	
Width to Depth Ratio:	10.91	
Rosgen Stream Classification:	E 4	


Tributary 2 XS 207+50
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.2
Dbkf = .53
Abkf = 3.26
Elevation (ft)
710
709
708
707
706
705
704
703
702
701
700
0
5
10
15
20
25
30
35
40
45
50
Horizontal Distance (ft)


Tributary 2 XS 210+00
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 10.2
Dbkf = .45
Abkf = 4.52
Elevation (ft)
704
703
702
701
700
699
698
697
696
695
694
0
5
10
15
20
25
30
35
40
45
50
Horizontal Distance (ft)

RIVERMORPH PARTICLE SUMMARY

River Name: Trib-2
Reach Name: Reach 2
Sample Name: XS-2 from trib 1
Survey Date: 08/26/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	1	1.00	1.00
0.062 - 0.125	0	0.00	1.00
0.125 - 0.25	0	0.00	1.00
0.25 - 0.50	0	0.00	1.00
0.50 - 1.0	7	7.00	8.00
1.0 - 2.0	1	1.00	9.00
2.0 - 4.0	3	3.00	12.00
4.0 - 5.7	3	3.00	15.00
5.7 - 8.0	8	8.00	23.00
8.0 - 11.3	8	8.00	31.00
11.3 - 16.0	15	15.00	46.00
16.0 - 22.6	22	22.00	68.00
22.6 - 32.0	10	10.00	78.00
32 - 45	12	12.00	90.00
45 - 64	8	8.00	98.00
64 - 90	1	1.00	99.00
90 - 128	1	1.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	5.99
D35 (mm)	12.55
D50 (mm)	17.2
D84 (mm)	38.5
D95 (mm)	56.88
D100 (mm)	128
Silt/Clay (%)	1
Sand (%)	8
Gravel (%)	89
Cobble (%)	2
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Trib-2
Reach Name: Reach 2 <-- This is not a Reference Reach
Drainage Area: 0.025 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 08/26/2008

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0242	ft/ft
Number of Channels:	Single	
Width:	6.2	ft
Mean Depth:	0.53	ft
Flood-Prone Width:	34.96	ft
Channel Materials D50:	11	mm
Water Surface Slope:	0.023	ft/ft
Sinuosity:	1.05	
Discharge:	13.2	cfs
Velocity:	4.05	fps
Cross Sectional Area:	3.26	sq ft
Entrenchment Ratio:	5.64	
Width to Depth Ratio:	11.7	
Rosgen Stream Classification:	E 4b	

Appendix C – Photo Log & RBP

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 1. East Fork Little Sandy 5/27/08		**Photo 2. East Fork Little Sandy 5/27/08**
		
Photo 3. East Fork Little Sandy 5/27/08		**Photo 4. East Fork Little Sandy 5/27/08**

East Fork Little Sandy Stream Restoration
Photo Log

		
Photo 5. East Fork Little Sandy 5/27/08		**Photo 6. East Fork Little Sandy 5/27/08**
		
Photo 7. East Fork Little Sandy 5/27/08		**Photo 8. East Fork Little Sandy 5/27/08**

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 9. East Fork Little Sandy 5/27/08		**Photo 10. East Fork Little Sandy 6/11/08**
		
Photo 11. East Fork Little Sandy 6/11/08		**Photo 12. East Fork Little Sandy 6/11/08**

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 13. East Fork Little Sandy 6/11/08		**Photo 14. East Fork Little Sandy 6/11/08**
		
Photo 15. East Fork Little Sandy 6/11/08		**Photo 16. East Fork Little Sandy 6/11/08**

East Fork Little Sandy Stream Restoration
Photo Log

		
Photo 17. East Fork Little Sandy 6/11/08		**Photo 18. East Fork Little Sandy 6/11/08**
		
Photo 19. East Fork Little Sandy 6/11/08		**Photo 20. EFLS Main Stem XS 3 Looking Upstream 8/13/08**

East Fork Little Sandy Stream Restoration

Photo Log

Photo 21. EFLS Main Stem XS 3 Looking Downstream 8/13/08

Photo 22. EFLS Restored Reach XS 1 Looking Upstream 8/13/08

Photo 23. EFLS Restored Reach XS 1 Looking Downstream 8/13/08

Photo 24. EFLS Restored Reach XS 2 Looking Upstream 8/13/08

East Fork Little Sandy Stream Restoration

Photo Log

Photo 25. EFLS Restored Reach XS 2 Looking Downstream 8/13/08

Photo 26. Little East Fork 6/11/08

Photo 27. Little East Fork 6/11/08

Photo 28. Little East Fork 6/11/08

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 29. Little East Fork 6/11/08		**Photo 30. Little East Fork 6/11/08**
		
Photo 31. Little East Fork 6/11/08		**Photo 32. Little East Fork 6/11/08**

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 33. Little East Fork 6/11/08		**Photo 34. Little East Fork 6/11/08**
		
Photo 35. Little East Fork 6/11/08		**Photo 36. Little East Fork 6/11/08**

East Fork Little Sandy Stream Restoration

Photo Log

		
Photo 37. Little East Fork 6/11/08		**Photo 38. Little East Fork 6/11/08**
		
Photo 39. Little East Fork 6/11/08		

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: East Fork Little Sandy River Main Stem

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	13	(0-20)
3. Velocity/Depth Regime	18	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	8	(0-20)
7. Freq. Of Riffles (bends)	8	(0-20)
8. Bank stability (both combined)	8	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	4	(0-20)

		Subindex
Total Habitat Score	97	
Habitat Integrity Index		0.10

Photograph

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Restoration

Stream/Reach: East Fork Little Sandy River Main Stem

Assessment Objectives: Predicted Final Habitat Quality of Restored Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	16	(0-20)
2. Embeddedness	14	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	16	(0-20)
6. Channel Alteration	15	(0-20)
7. Freq. Of Riffles (bends)	18	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	16	(0-20)
10. Riparian Width (both combined)	14	(0-20)

		Subindex
Total Habitat Score	162	
Habitat Integrity Index		0.87

Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.86	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork River R1

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	3	(0-20)
3. Velocity/Depth Regime	18	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	8	(0-20)
7. Freq. Of Riffles (bends)	8	(0-20)
8. Bank stability (both combined)	2	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	4	(0-20)

Total Habitat Score	81	**Subindex**
Habitat Integrity Index		0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork River R1

Assessment Objectives: Predict Final Habitat Quality of Restored Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	15	(0-20)
2. Embeddedness	16	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	16	(0-20)
6. Channel Alteration	16	(0-20)
7. Freq. Of Riffles (bends)	17	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	16	(0-20)
10. Riparian Width (both combined)	13	(0-20)
Total Habitat Score	162	

	Subindex
Habitat Integrity Index	0.87

Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.86	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork River Reach 2

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	3	(0-20)
3. Velocity/Depth Regime	18	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	8	(0-20)
7. Freq. Of Riffles (bends)	8	(0-20)
8. Bank stability (both combined)	2	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	2	(0-20)

Total Habitat Score	79	**Subindex**
Habitat Integrity Index		0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork River Reach 2

Assessment Objectives: Predict Final Habitat Quality of Restored Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	14	(0-20)
2. Embeddedness	14	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	16	(0-20)
6. Channel Alteration	13	(0-20)
7. Freq. Of Riffles (bends)	16	(0-20)
8. Bank stability (both combined)	10	(0-20)
9. Veg. Protection (both combined)	12	(0-20)
10. Riparian Width (both combined)	10	(0-20)
Total Habitat Score	**140**	

	Subindex
Habitat Integrity Index	**0.50**

Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**203**	microMHOs	**0.85**

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.67	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork Trib

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

N/A

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	3	(0-20)
3. Velocity/Depth Regime	8	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	8	(0-20)
7. Freq. Of Riffles (bends)	8	(0-20)
8. Bank stability (both combined)	2	(0-20)
9. Veg. Protection (both combined)	10	(0-20)
10. Riparian Width (both combined)	2	(0-20)

		Subindex
Total Habitat Score	65	
Habitat Integrity Index		0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Little East Fork Trib

Assessment Objectives: Predict Final Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	15	(0-20)
2. Embeddedness	15	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	16	(0-20)
6. Channel Alteration	16	(0-20)
7. Freq. Of Riffles (bends)	16	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	16	(0-20)
10. Riparian Width (both combined)	13	(0-20)

		Subindex
Total Habitat Score	160	
Habitat Integrity Index		0.83

Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.84	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 1

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	8	(0-20)
3. Velocity/Depth Regime	17	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	13	(0-20)
7. Freq. Of Riffles (bends)	15	(0-20)
8. Bank stability (both combined)	8	(0-20)
9. Veg. Protection (both combined)	9	(0-20)
10. Riparian Width (both combined)	14	(0-20)
Total Habitat Score	108	

	Subindex
Habitat Integrity Index	0.18

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.51	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 1

Assessment Objectives: Predicted Final Habitat Quality of Restored Reach

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	15	(0-20)
2. Embeddedness	15	(0-20)
3. Velocity/Depth Regime	20	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	14	(0-20)
6. Channel Alteration	18	(0-20)
7. Freq. Of Riffles (bends)	16	(0-20)
8. Bank stability (both combined)	17	(0-20)
9. Veg. Protection (both combined)	16	(0-20)
10. Riparian Width (both combined)	16	(0-20)
Total Habitat Score	163	

	Subindex
Habitat Integrity Index	0.88

Upstream Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.87	(Habitat Integrity + Conductivity)

Downstream Photograph

PHOTO NOT AVAILABLE

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 2

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	8	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	13	(0-20)
7. Freq. Of Riffles (bends)	15	(0-20)
8. Bank stability (both combined)	8	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	14	(0-20)
Total Habitat Score	115	

	Subindex
Habitat Integrity Index	0.25

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.55	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 2

Assessment Objectives: Predicted Final Habitat Quality of Restored Reach

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	18	(0-20)
2. Embeddedness	16	(0-20)
3. Velocity/Depth Regime	19	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	14	(0-20)
6. Channel Alteration	17	(0-20)
7. Freq. Of Riffles (bends)	12	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	18	(0-20)
10. Riparian Width (both combined)	16	(0-20)
Total Habitat Score	164	

	Subindex
Habitat Integrity Index	0.90

Upstream Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.87	(Habitat Integrity + Conductivity)

Downstream Photograph

PHOTO NOT AVAILABLE

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 3

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	6	(0-20)
3. Velocity/Depth Regime	20	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	8	(0-20)
7. Freq. Of Riffles (bends)	10	(0-20)
8. Bank stability (both combined)	10	(0-20)
9. Veg. Protection (both combined)	12	(0-20)
10. Riparian Width (both combined)	4	(0-20)
Total Habitat Score	94	

Subindex
0.10

Habitat Integrity Index

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1 Reach 3

Assessment Objectives: Predicted Final Habitat Quality of Restored Reach

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	15	(0-20)
2. Embeddedness	16	(0-20)
3. Velocity/Depth Regime	18	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	16	(0-20)
6. Channel Alteration	18	(0-20)
7. Freq. Of Riffles (bends)	16	(0-20)
8. Bank stability (both combined)	16	(0-20)
9. Veg. Protection (both combined)	16	(0-20)
10. Riparian Width (both combined)	15	(0-20)
Total Habitat Score	162	

Subindex
0.87

Habitat Integrity Index

Upstream Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**203**	microMHOs	**0.85**

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.86	(Habitat Integrity + Conductivity)

Downstream Photograph

PHOTO NOT AVAILABLE

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1A

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	8	(0-20)
2. Embeddedness	8	(0-20)
3. Velocity/Depth Regime	15	(0-20)
4. Sediment Deposition	8	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	13	(0-20)
7. Freq. Of Riffles (bends)	15	(0-20)
8. Bank stability (both combined)	8	(0-20)
9. Veg. Protection (both combined)	8	(0-20)
10. Riparian Width (both combined)	8	(0-20)
Total Habitat Score	99	

	Subindex
Habitat Integrity Index	0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 1A

Assessment Objectives: Predicted Final Habitat Quality of Impacted Reach

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	15	(0-20)
2. Embeddedness	15	(0-20)
3. Velocity/Depth Regime	16	(0-20)
4. Sediment Deposition	15	(0-20)
5. Channel Flow Status	10	(0-20)
6. Channel Alteration	15	(0-20)
7. Freq. Of Riffles (bends)	16	(0-20)
8. Bank stability (both combined)	14	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	14	(0-20)
Total Habitat Score	144	

	Subindex
Habitat Integrity Index	0.57

Upstream Photograph

PHOTO NOT AVAILABLE

Downstream Photograph

PHOTO NOT AVAILABLE

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.71	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 2 Reach 1

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	18	(0-20)
2. Embeddedness	3	(0-20)
3. Velocity/Depth Regime	3	(0-20)
4. Sediment Deposition	13	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	3	(0-20)
7. Freq. Of Riffles (bends)	6	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	18	(0-20)
10. Riparian Width (both combined)	4	(0-20)

		Subindex
Total Habitat Score	94	
Habitat Integrity Index		0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 2 Reach 1

Assessment Objectives: Predicted Final Habitat Quality of RestoredReach

Upstream Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	18	(0-20)
2. Embeddedness	15	(0-20)
3. Velocity/Depth Regime	15	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	8	(0-20)
6. Channel Alteration	16	(0-20)
7. Freq. Of Riffles (bends)	8	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	18	(0-20)
10. Riparian Width (both combined)	15	(0-20)
Total Habitat Score	147	

Subindex
0.62

Habitat Integrity Index

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.73	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 2 Reach 2

Assessment Objectives: Determined Habitat Quality of Impacted Reach

Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	16	(0-20)
2. Embeddedness	3	(0-20)
3. Velocity/Depth Regime	3	(0-20)
4. Sediment Deposition	13	(0-20)
5. Channel Flow Status	13	(0-20)
6. Channel Alteration	3	(0-20)
7. Freq. Of Riffles (bends)	13	(0-20)
8. Bank stability (both combined)	14	(0-20)
9. Veg. Protection (both combined)	14	(0-20)
10. Riparian Width (both combined)	4	(0-20)
Total Habitat Score	96	

	Subindex
Habitat Integrity Index	0.10

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	203	microMHOs	0.85

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.47	(Habitat Integrity + Conductivity)

RBP and EII Calculator

(Adapted from EII Calculation for High Gradient Streams in Eastern Kentucky Coalfield Version 2002.6)

Project ID: East Fork Little Sandy Stream Restoration

Stream/Reach: Tributary 2 Reach 2

Assessment Objectives: Predicted Final Habitat Quality of Restored Reach

Upstream Photograph

PHOTO NOT AVAILABLE

RBP Habitat Parameters	Measure	Units
1. Epifaunal Substrate	18	(0-20)
2. Embeddedness	16	(0-20)
3. Velocity/Depth Regime	17	(0-20)
4. Sediment Deposition	16	(0-20)
5. Channel Flow Status	15	(0-20)
6. Channel Alteration	17	(0-20)
7. Freq. Of Riffles (bends)	12	(0-20)
8. Bank stability (both combined)	18	(0-20)
9. Veg. Protection (both combined)	18	(0-20)
10. Riparian Width (both combined)	16	(0-20)
Total Habitat Score	**163**	

	Subindex
Habitat Integrity Index	**0.88**

Macroinvertebrate Data - Family Level (All Habitats)

11. Family Taxa Richness		# of taxa sampled
12. Family EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. mFBI		no units

Macroinvertebrate Bioassessment	**NA**	no units	**NA**
Conductivity	**203**	microMHOs	**0.85**

EII	Model
NA	(MBI + Habitat Integrity + Conductivity)
0.87	(Habitat Integrity + Conductivity)

Appendix D – Reference Reach

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: EF Little Sandy River
Reach Name: Restored Reach <-- This is a Reference Reach
Drainage Area: 10 sq mi
State: Kentucky
County: Lawrence
Latitude: 0
Longitude: 0
Survey Date: 08/13/2008

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0017	ft/ft
Number of Channels:	Single	
Width:	31.55	ft
Mean Depth:	1.49	ft
Flood-Prone Width:	59.86	ft
Channel Materials D50:	0.65	mm
Water Surface Slope:	0.0015	ft/ft
Sinuosity:	1.1	
Discharge:	156	cfs
Velocity:	2.89	fps
Cross Sectional Area:	46.85	sq ft
Entrenchment Ratio:	1.9	
Width to Depth Ratio:	21.17	
Rosgen Stream Classification:	B 5c	

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Restored Reach
Sample Name: Riffle XS-1
Survey Date: 08/13/2008

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	8	8.00	8.00
0.50 - 1.0	3	3.00	11.00
1.0 - 2.0	1	1.00	12.00
2.0 - 4.0	1	1.00	13.00
4.0 - 5.7	9	9.00	22.00
5.7 - 8.0	12	12.00	34.00
8.0 - 11.3	26	26.00	60.00
11.3 - 16.0	18	18.00	78.00
16.0 - 22.6	17	17.00	95.00
22.6 - 32.0	4	4.00	99.00
32 - 45	1	1.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	4.57
D35 (mm)	8.13
D50 (mm)	10.03
D84 (mm)	18.33
D95 (mm)	22.6
D100 (mm)	45
Silt/Clay (%)	0
Sand (%)	12
Gravel (%)	88
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

RIVERMORPH PARTICLE SUMMARY

River Name: EF Little Sandy River
Reach Name: Restored Reach
Sample Name: Bar Sample
Survey Date: 08/25/2008

SIEVE (mm)	NET WT
16	9.46
8	224.59
4	538.95
2	749.79
0.85	2068.35
0.6	1730.1
0.3	1347.67
0.15	92.19
0.075	16.3
PAN	9.58
D16 (mm)	0.52
D35 (mm)	0.73
D50 (mm)	0.96
D84 (mm)	3.18
D95 (mm)	7.28
D100 (mm)	10.63
Silt/Clay (%)	0
Sand (%)	77.47
Gravel (%)	22.53
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Weight = 6795.0000.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	10.63	4.16
Particle 2:	10.6	3.86

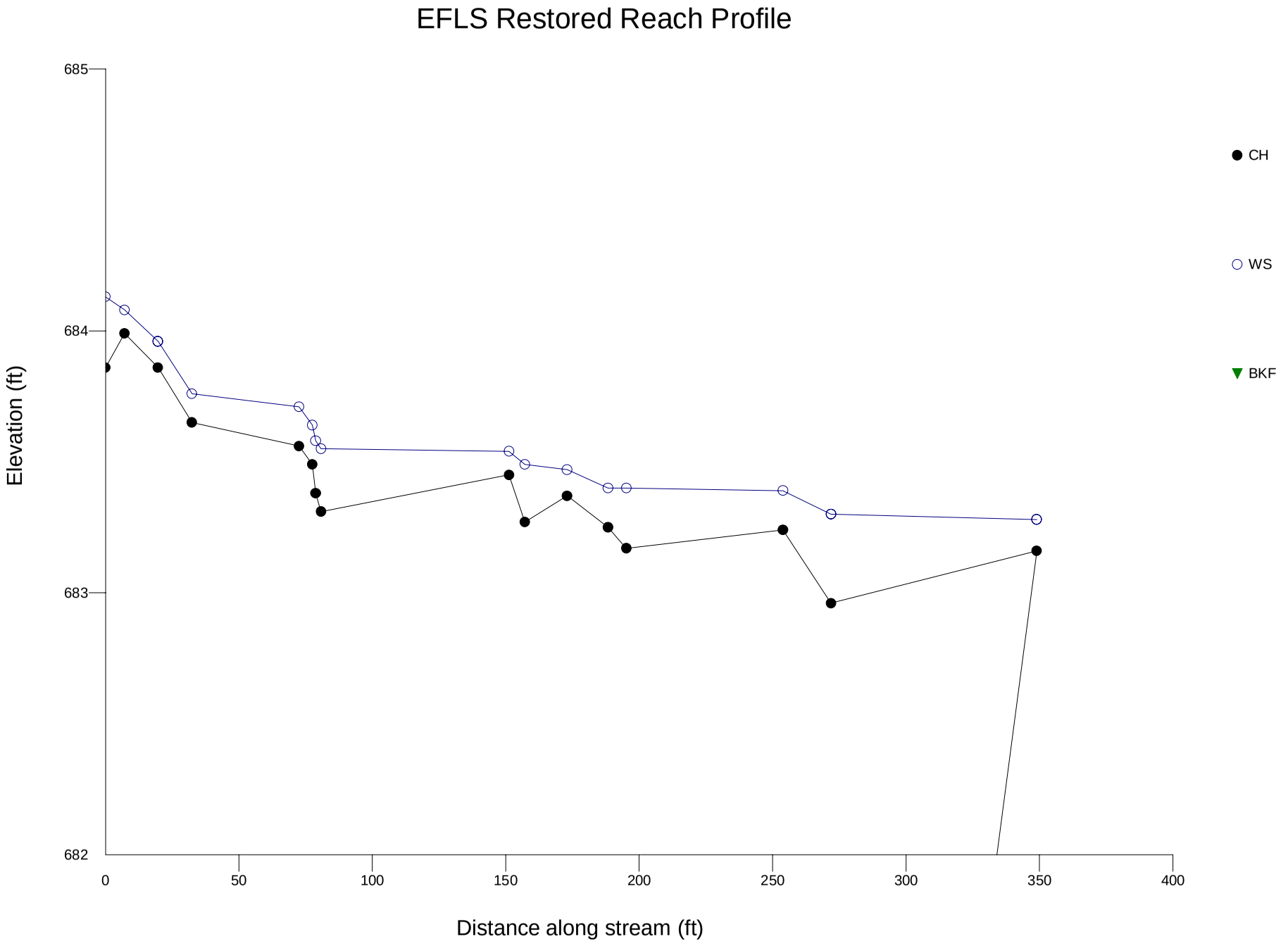
RIVERMORPH PARTICLE SUMMARY

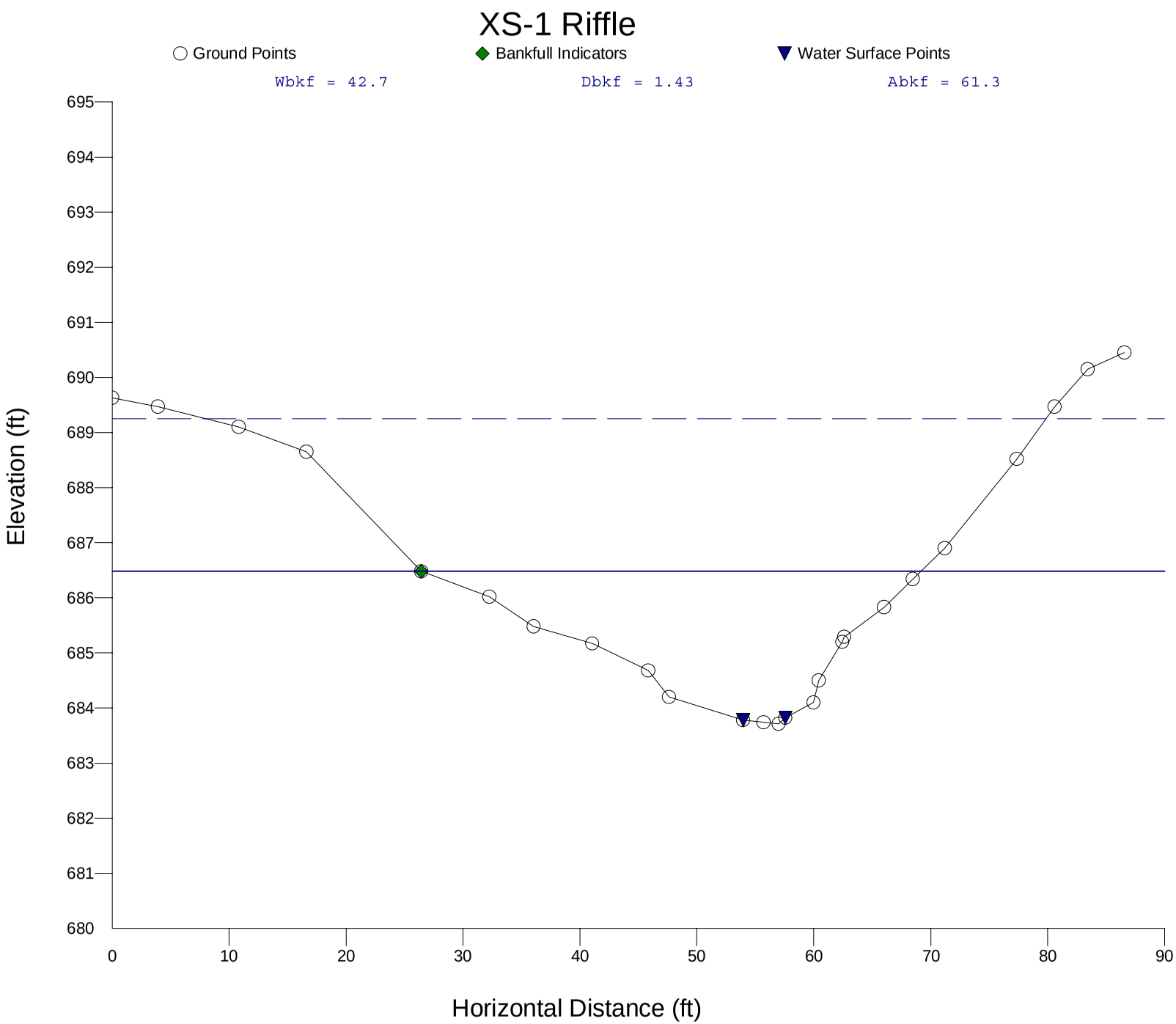
River Name: Flagg Spring Creek
Reach Name: No 2 (B4c)
Sample Name: RIFFLE
Survey Date: 02/27/2003

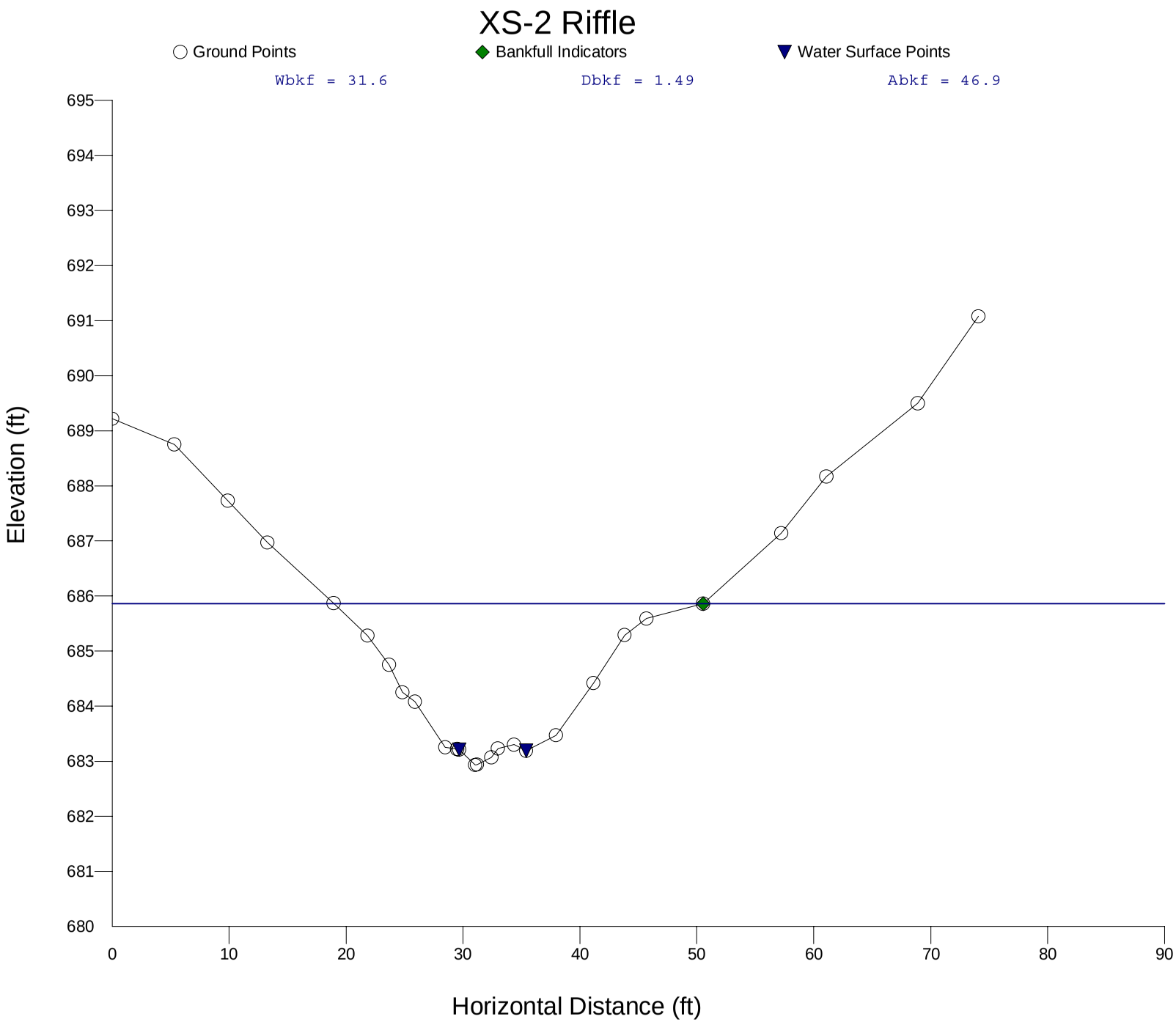
Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	5	7.46	7.46
0.50 - 1.0	5	7.46	14.93
1.0 - 2.0	9	13.43	28.36
2.0 - 4.0	8	11.94	40.30
4.0 - 5.7	7	10.45	50.75
5.7 - 8.0	11	16.42	67.16
8.0 - 11.3	11	16.42	83.58
11.3 - 16.0	10	14.93	98.51
16.0 - 22.6	1	1.49	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	1.08
D35 (mm)	3.11
D50 (mm)	5.58
D84 (mm)	11.43
D95 (mm)	14.9
D100 (mm)	22.6
Silt/Clay (%)	0
Sand (%)	28.36
Gravel (%)	71.64
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 67.


EFLS Restored Reach Profile
685
684
683
682
Elevation (ft)
0
50
100
150
200
250
300
350
400
Distance along stream (ft)
CH
WS
BKF


XS-1 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 42.7
Dbkf = 1.43
Abkf = 61.3
Elevation (ft)
695
694
693
692
691
690
689
688
687
686
685
684
683
682
681
680
0
10
20
30
40
50
60
70
80
90
Horizontal Distance (ft)


XS-2 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 31.6
Dbkf = 1.49
Abkf = 46.9
Elevation (ft)
695
694
693
692
691
690
689
688
687
686
685
684
683
682
681
680
0
10
20
30
40
50
60
70
80
90
Horizontal Distance (ft)

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Hyatts Fork (C4)
Reach Name: Hyatts Fork RR <-- This is a Reference Reach
Drainage Area: 1.8 sq mi
State: Kentucky
County: Pulaski
Latitude: 0
Longitude: 0
Survey Date: 01/27/2003

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0124	ft/ft
Number of Channels:	Single	
Width:	18.67	ft
Mean Depth:	1.4	ft
Flood-Prone Width:	150	ft
Channel Materials D50:	25.73	mm
Water Surface Slope:	0.00868	ft/ft
Sinuosity:	1.1	
Discharge:	100	cfs
Velocity:	4	fps
Cross Sectional Area:	26.15	sq ft
Entrenchment Ratio:	8.03	
Width to Depth Ratio:	13.34	
Rosgen Stream Classification:	C 4	

RIVERMORPH PARTICLE SUMMARY

River Name: Hyatts Fork (C4)
Reach Name: Hyatts Fork RR
Sample Name: Rifle
Survey Date: 01/27/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	0	0.00	0.00
1.0 - 2.0	1	0.91	0.91
2.0 - 4.0	2	1.82	2.73
4.0 - 5.7	7	6.36	9.09
5.7 - 8.0	4	3.64	12.73
8.0 - 11.3	5	4.55	17.27
11.3 - 16.0	9	8.18	25.45
16.0 - 22.6	11	10.00	35.45
22.6 - 32.0	24	21.82	57.27
32 - 45	15	13.64	70.91
45 - 64	13	11.82	82.73
64 - 90	6	5.45	88.18
90 - 128	5	4.55	92.73
128 - 180	3	2.73	95.45
180 - 256	3	2.73	98.18
256 - 362	2	1.82	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	10.38
D35 (mm)	22.3
D50 (mm)	28.87
D84 (mm)	70.06
D95 (mm)	171.4
D100 (mm)	361.99
Silt/Clay (%)	0
Sand (%)	0.91
Gravel (%)	81.82
Cobble (%)	15.45
Boulder (%)	1.82
Bedrock (%)	0

Total Particles = 110.

RIVERMORPH PARTICLE SUMMARY

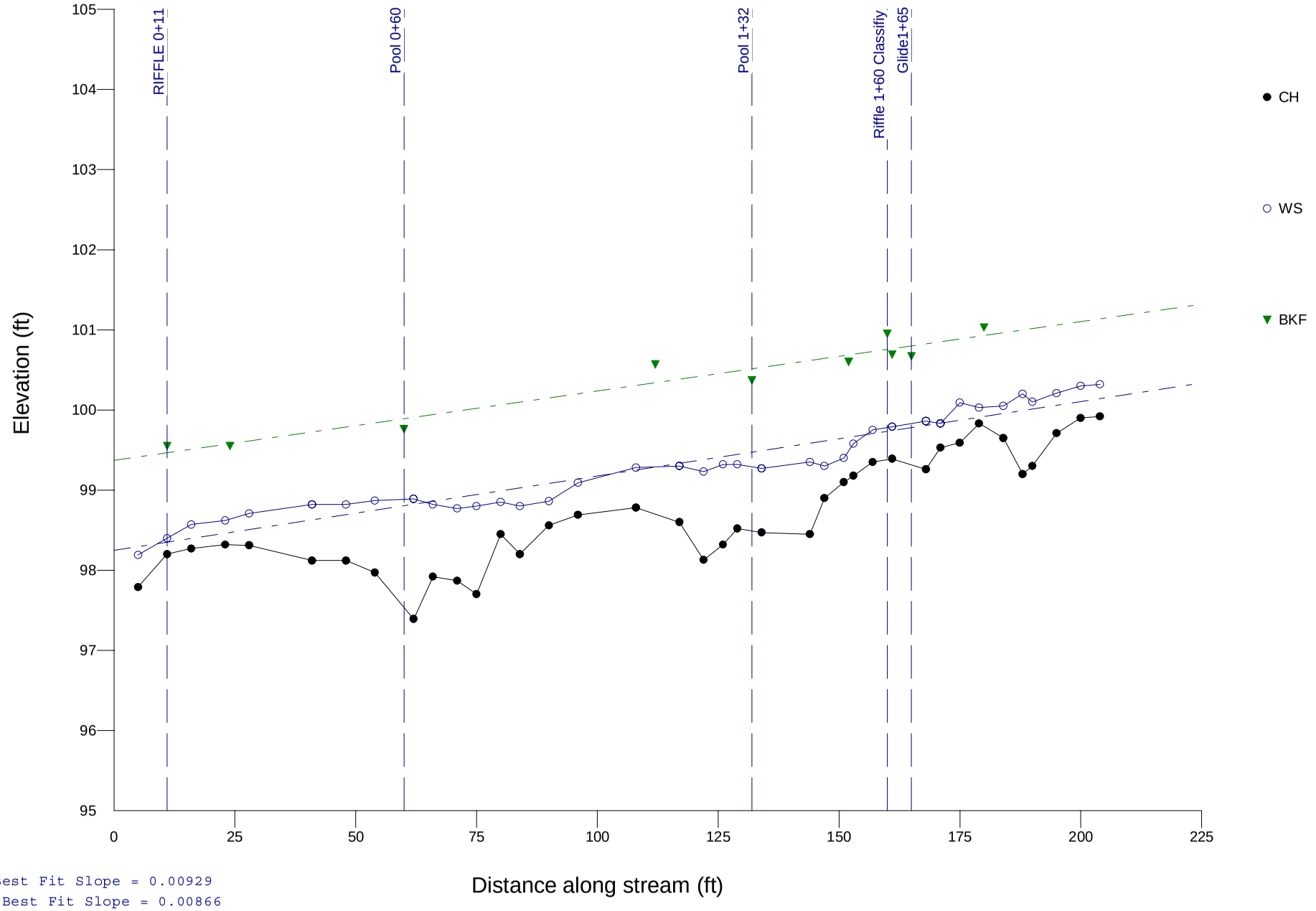
River Name: Hyatts Fork (C4)
Reach Name: Hyatts Fork RR
Sample Name: Reach Average
Survey Date: 01/27/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	2	1.89	1.89
0.50 - 1.0	0	0.00	1.89
1.0 - 2.0	0	0.00	1.89
2.0 - 4.0	3	2.83	4.72
4.0 - 5.7	6	5.66	10.38
5.7 - 8.0	5	4.72	15.09
8.0 - 11.3	6	5.66	20.75
11.3 - 16.0	4	3.77	24.53
16.0 - 22.6	21	19.81	44.34
22.6 - 32.0	18	16.98	61.32
32 - 45	11	10.38	71.70
45 - 64	9	8.49	80.19
64 - 90	7	6.60	86.79
90 - 128	7	6.60	93.40
128 - 180	4	3.77	97.17
180 - 256	2	1.89	99.06
256 - 362	1	0.94	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

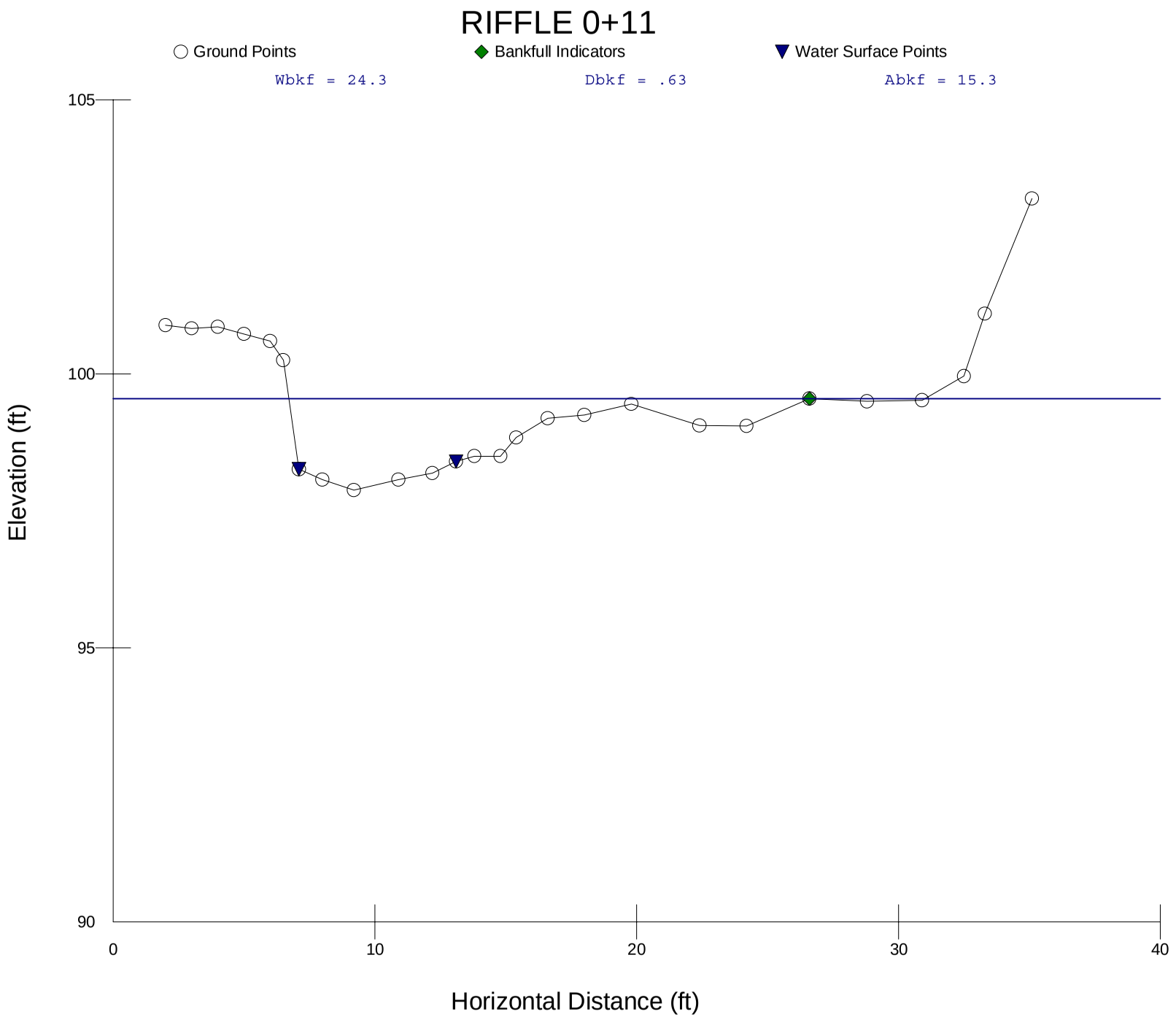
D16 (mm)	8.53
D35 (mm)	19.49
D50 (mm)	25.73
D84 (mm)	79.01
D95 (mm)	150.07
D100 (mm)	361.99
Silt/Clay (%)	0
Sand (%)	1.89
Gravel (%)	78.3
Cobble (%)	18.87
Boulder (%)	0.94
Bedrock (%)	0

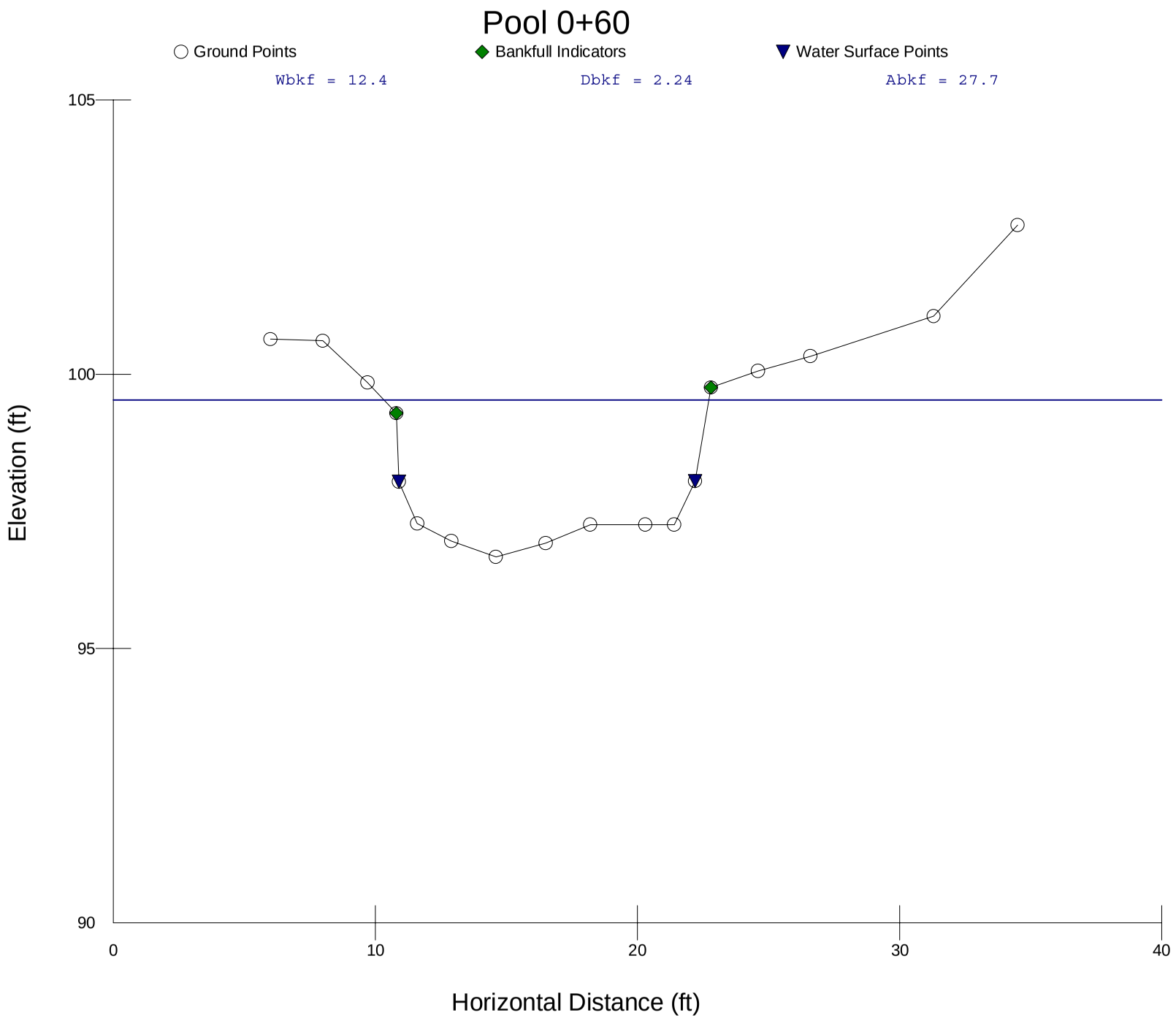
Total Particles = 106.

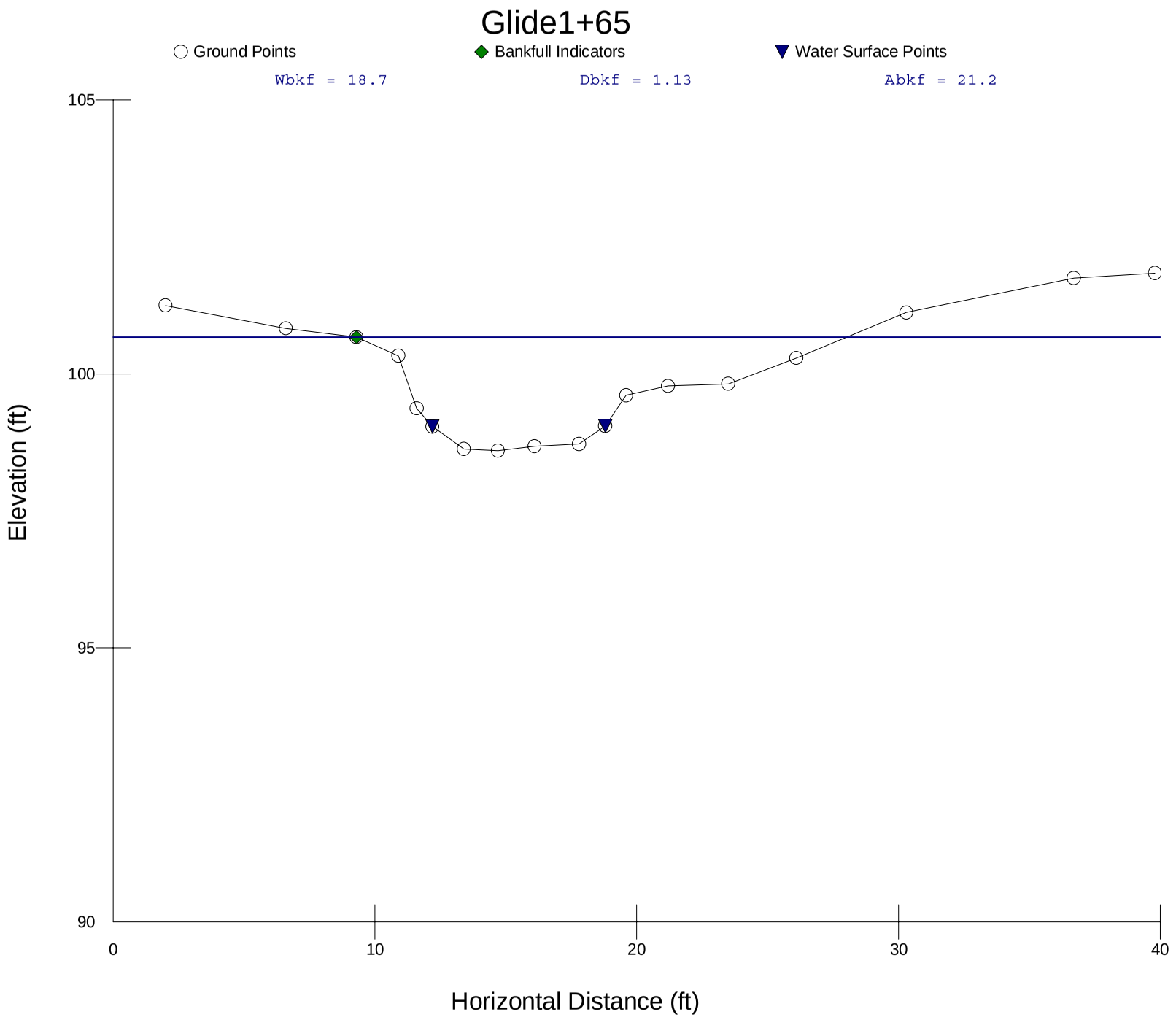
Hyatts Fork Profile

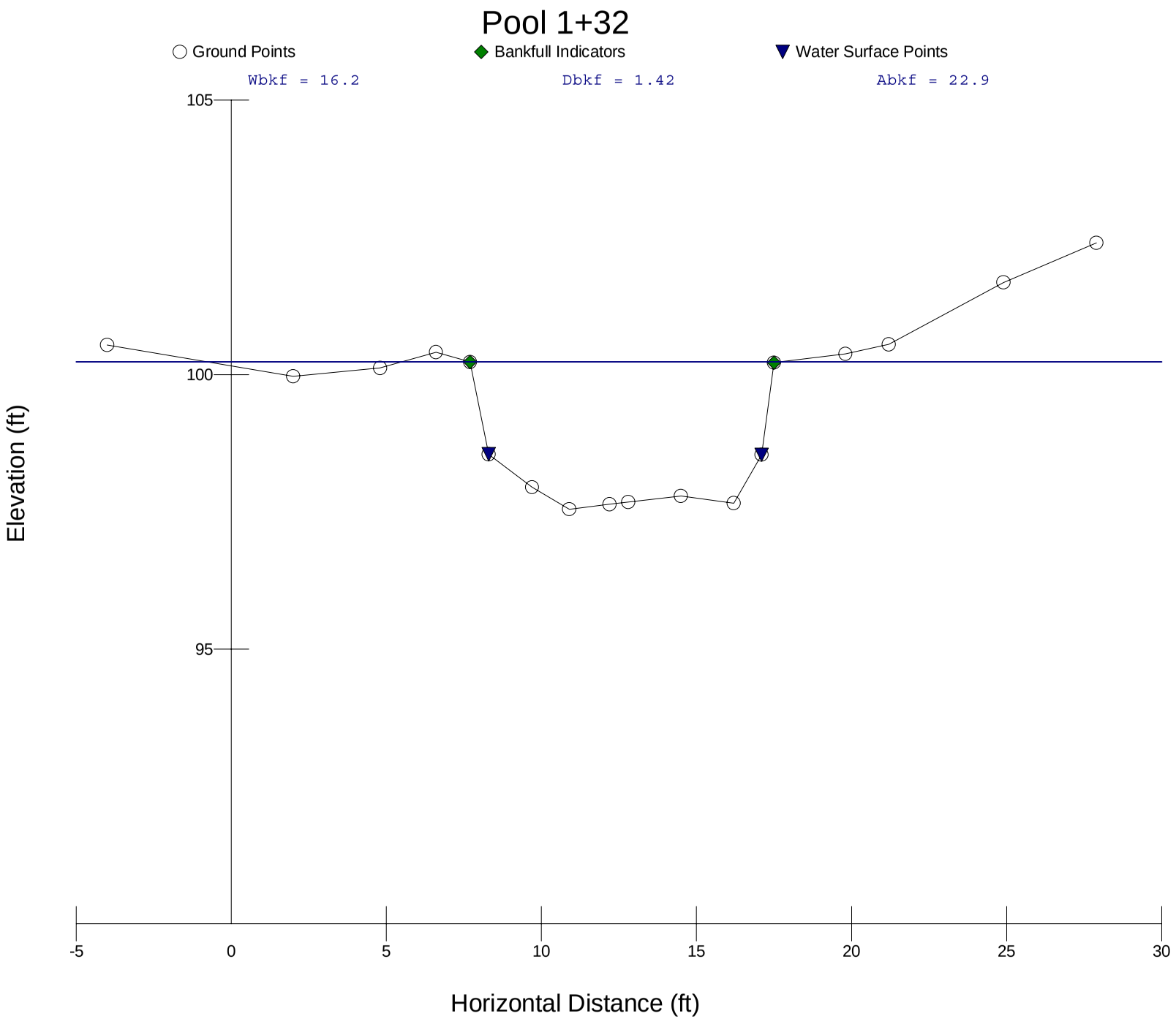


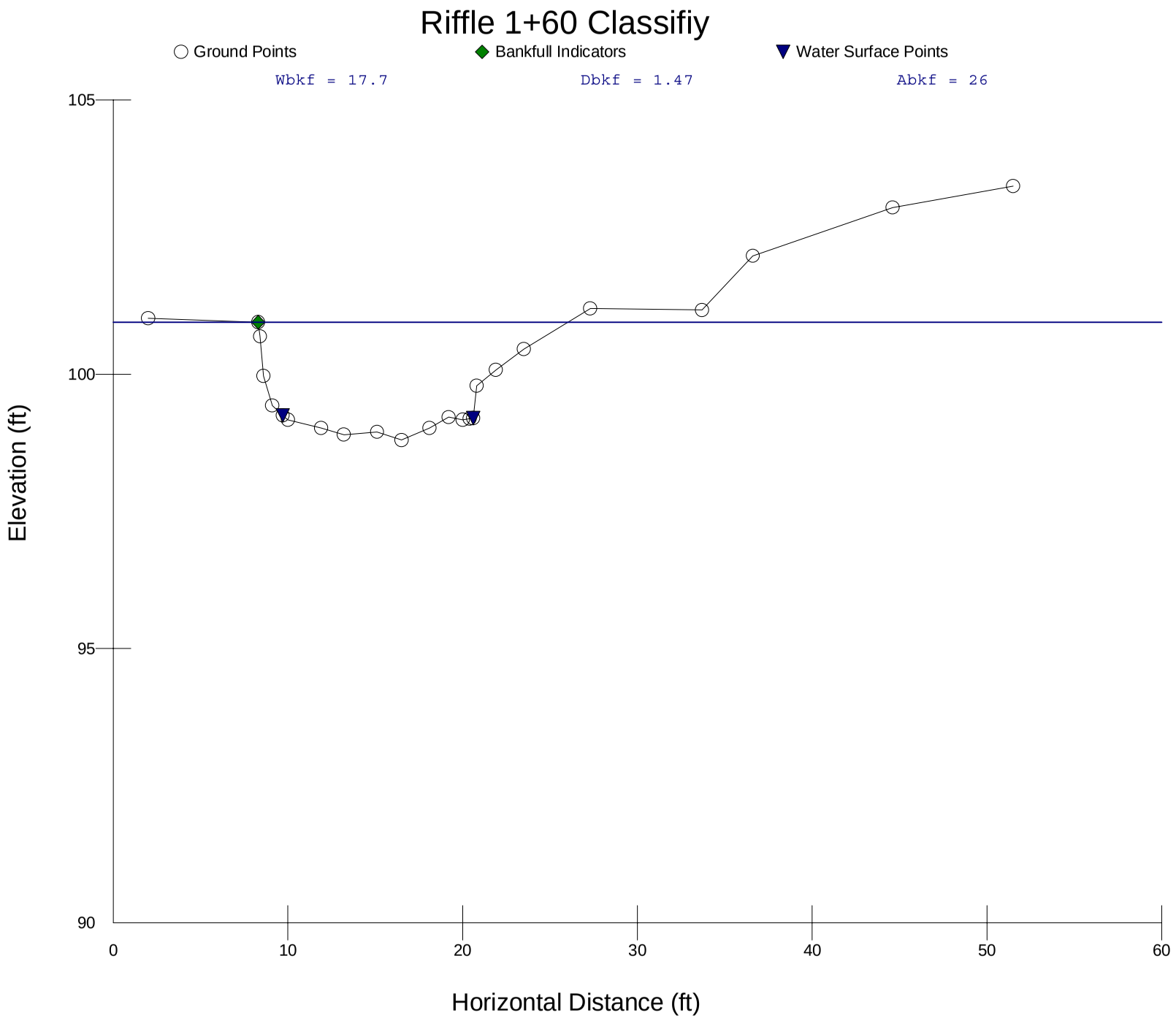
WS Best Fit Slope = 0.00929
BKF Best Fit Slope = 0.00866


RIFFLE 0+11
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 24.3
Dbkf = .63
Abkf = 15.3
105
100
95
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Pool 0+60
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 12.4
Dbkf = 2.24
Abkf = 27.7
105
100
95
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Glide1+65
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.7
Dbkf = 1.13
Abkf = 21.2
105
100
95
90
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)


Pool 1+32
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 16.2
Dbkf = 1.42
Abkf = 22.9
105
100
95
Elevation (ft)
-5
0
5
10
15
20
25
30
Horizontal Distance (ft)


Riffle 1+60 Classifiy
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.7
Dbkf = 1.47
Abkf = 26
105
100
95
90
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Flagg Spring Creek
Reach Name: No 2 (B4c) <-- This is a Reference Reach
Drainage Area: 0.092 sq mi
State: Kentucky
County: Campbell
Latitude: 0
Longitude: 0
Survey Date: 02/13/2003

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0141	ft/ft
Number of Channels:	Single	
Width:	6.19	ft
Mean Depth:	0.52	ft
Flood-Prone Width:	12.49	ft
Channel Materials D50:	3.1	mm
Water Surface Slope:	0.01163	ft/ft
Sinuosity:	1.215	
Discharge:	0	cfs
Velocity:	0	fps
Cross Sectional Area:	3.21	sq ft
Entrenchment Ratio:	2.02	
Width to Depth Ratio:	11.9	
Rosgen Stream Classification:	B 4c	

RIVERMORPH PARTICLE SUMMARY

River Name: Flagg Spring Creek
Reach Name: No 2 (B4c)
Sample Name: BAR SAMPLE
Survey Date: 02/27/2003

SIEVE (mm)	NET WT
12.5	27.41
6.3	427.1
4.75	553.3
2	719.6
0.425	130.25
0.15	122.83
0.075	34.6
PAN	384.91
D16 (mm)	0
D35 (mm)	2.64
D50 (mm)	4.02
D84 (mm)	7.32
D95 (mm)	11.16
D100 (mm)	
Silt/Clay (%)	0
Sand (%)	28.02
Gravel (%)	70.09
Cobble (%)	-0.63
Boulder (%)	1.88
Bedrock (%)	0.63

Total Weight = 2400.0000.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:		
Particle 2:		

RIVERMORPH PARTICLE SUMMARY

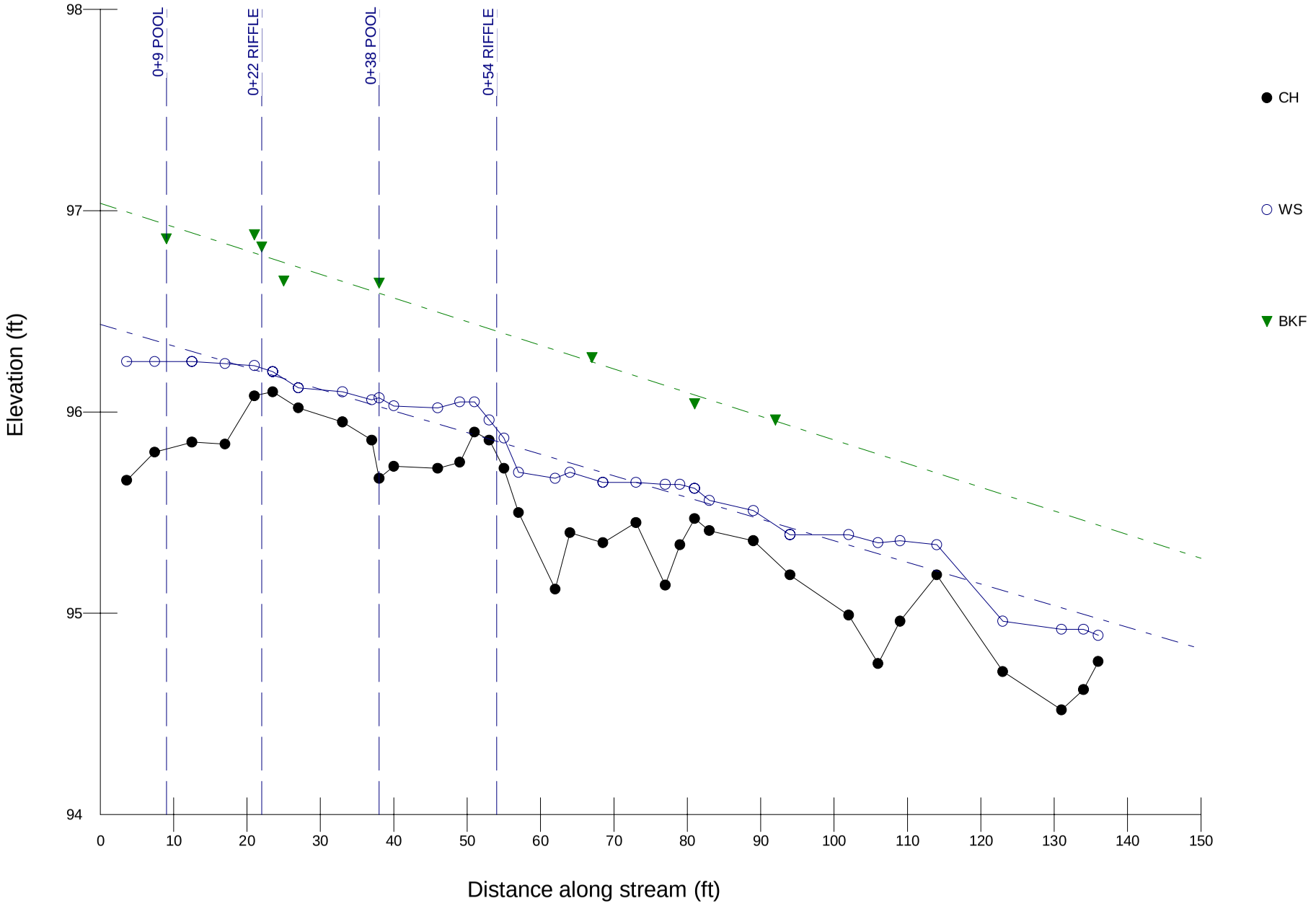
River Name: Flagg Spring Creek
Reach Name: No 2 (B4c)
Sample Name: REACH
Survey Date: 02/27/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	1	1.61	1.61
0.25 - 0.50	1	1.61	3.23
0.50 - 1.0	4	6.45	9.68
1.0 - 2.0	14	22.58	32.26
2.0 - 4.0	20	32.26	64.52
4.0 - 5.7	7	11.29	75.81
5.7 - 8.0	9	14.52	90.32
8.0 - 11.3	1	1.61	91.94
11.3 - 16.0	2	3.23	95.16
16.0 - 22.6	2	3.23	98.39
22.6 - 32.0	0	0.00	98.39
32 - 45	1	1.61	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

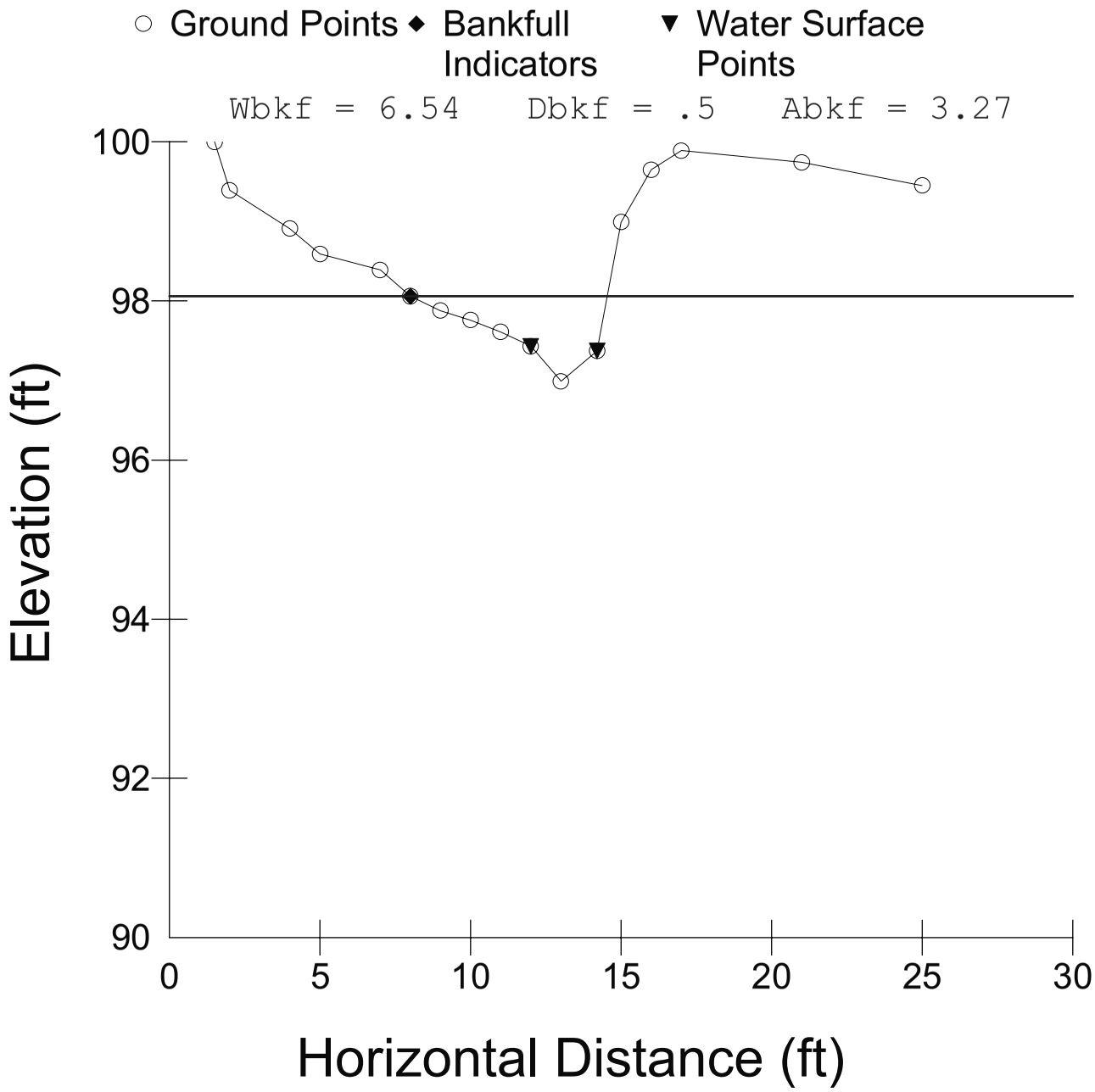
D16 (mm)	1.28
D35 (mm)	2.17
D50 (mm)	3.1
D84 (mm)	7
D95 (mm)	15.77
D100 (mm)	45
Silt/Clay (%)	0
Sand (%)	32.26
Gravel (%)	67.74
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 62.

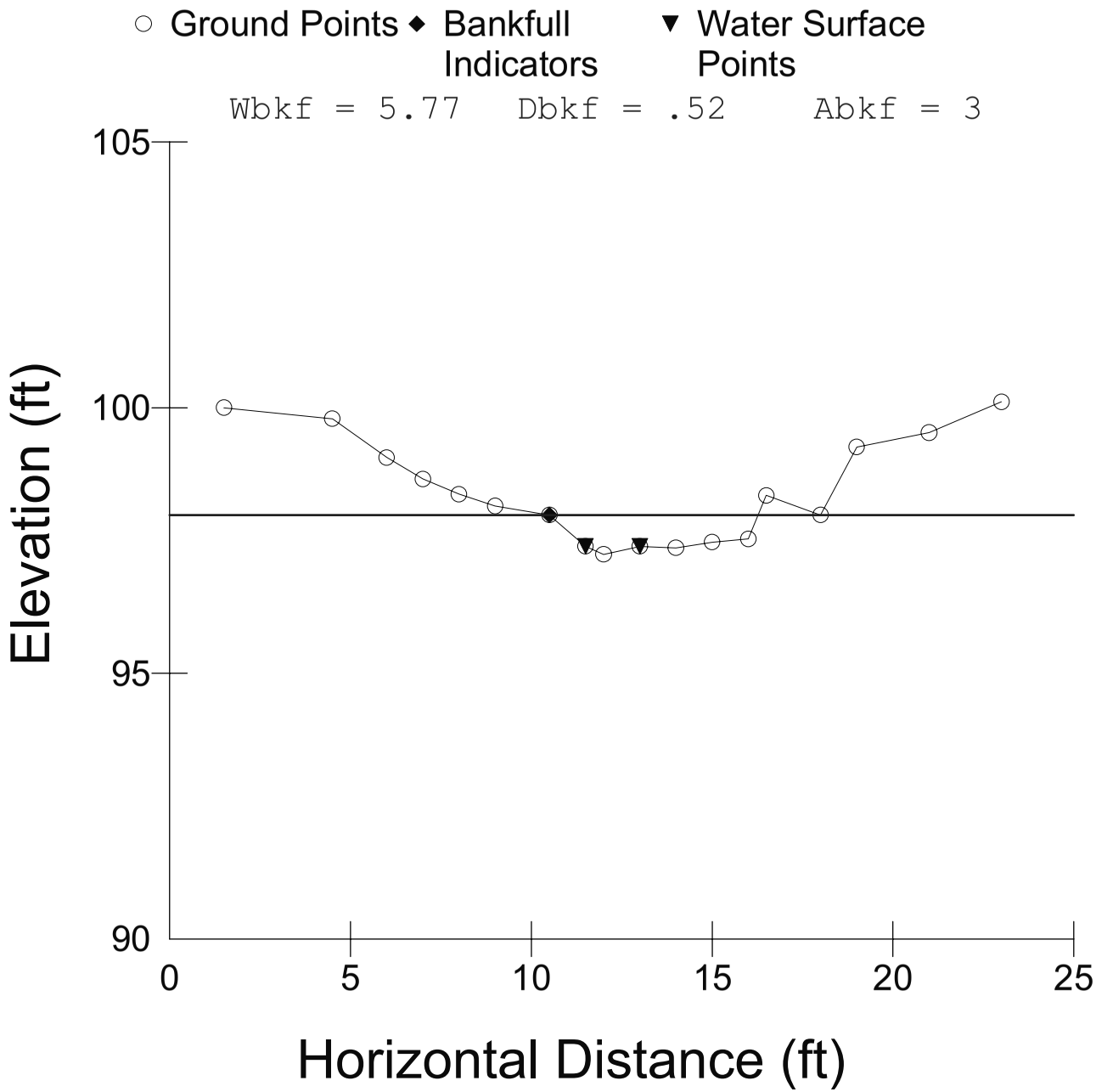
Flagg Spring Creek Profile



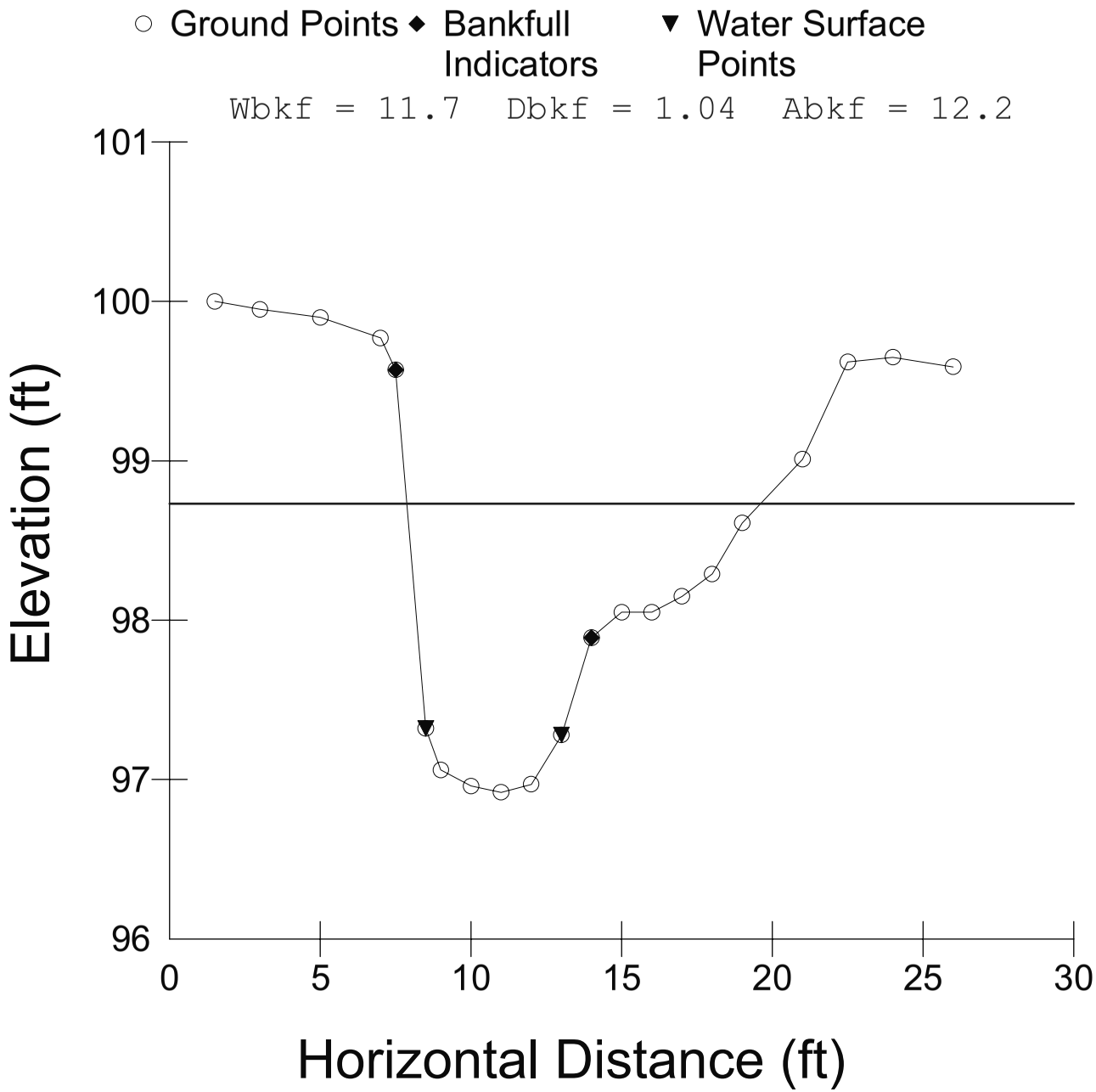
0+9 POOL


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 6.54
Dbkf = .5
Abkf = 3.27
100
98
96
94
92
90
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

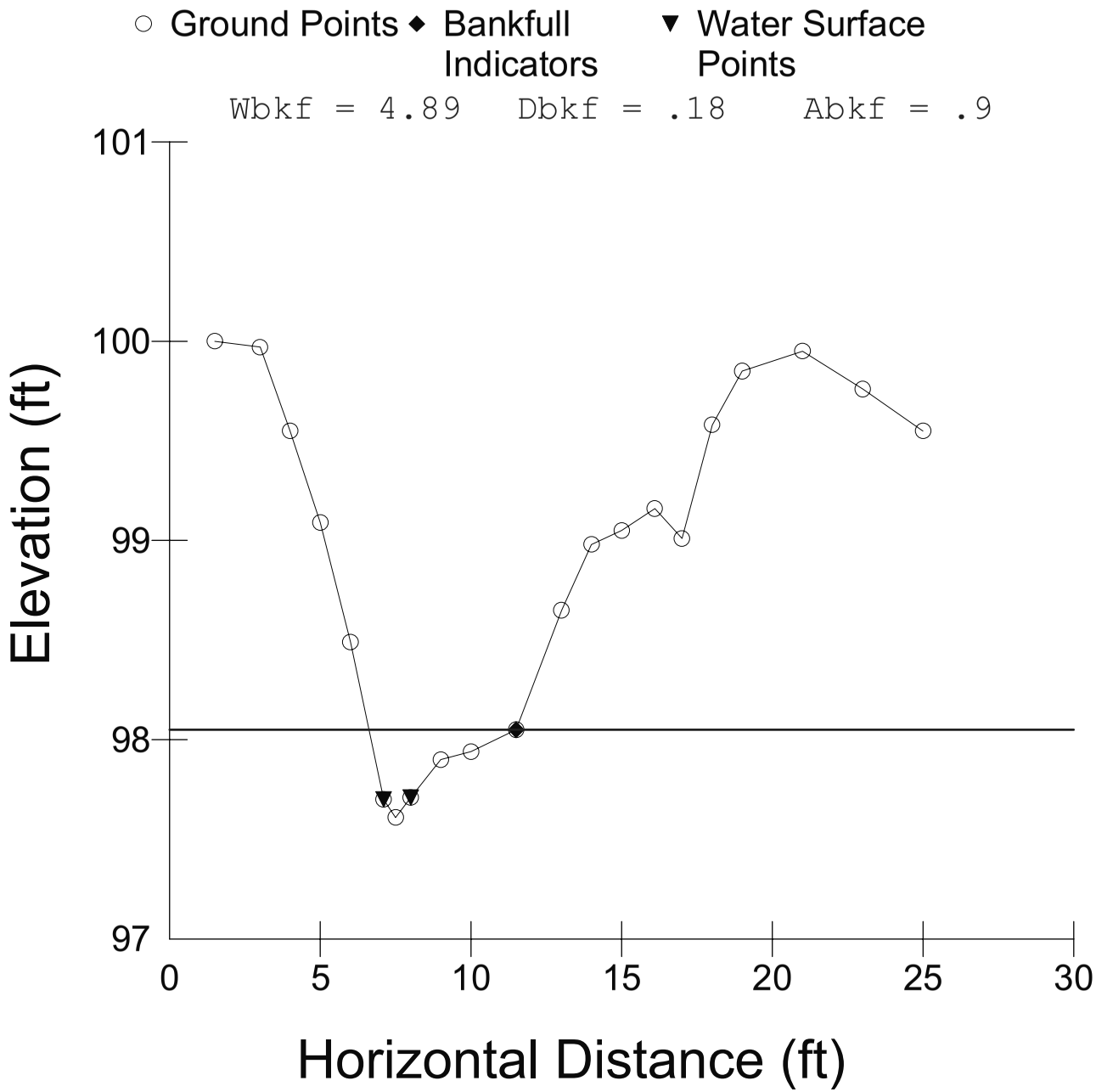
0+22 RIFFLE


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 5.77
Dbkf = .52
Abkf = 3
105
100
95
90
Elevation (ft)
0
5
10
15
20
25
Horizontal Distance (ft)

0+38 POOL


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 11.7 Dbkf = 1.04 Abkf = 12.2
101
100
99
98
97
96
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

0+54 RIFFLE


○ Ground Points
◆ Bankfull Indicators
▼ Water Surface Points
Wbkf = 4.89
Dbkf = .18
Abkf = .9
101
100
99
98
97
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

RIVERMORPH STREAM CHANNEL CLASSIFICATION

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1 <-- This is a Reference Reach
Drainage Area: 0.24 sq mi
State: Kentucky
County: Adair
Latitude: 36.70556
Longitude: 84.21806
Survey Date: 09/04/2003

Classification Data

Valley Type:	Type VIII	
Valley Slope:	0.0263	ft/ft
Number of Channels:	Single	
Width:	11.25	ft
Mean Depth:	0.87	ft
Flood-Prone Width:	200	ft
Channel Materials D50:	26.83	mm
Water Surface Slope:	0.02288	ft/ft
Sinuosity:	1.15	
Discharge:	37	cfs
Velocity:	0	fps
Cross Sectional Area:	9.82	sq ft
Entrenchment Ratio:	17.78	
Width to Depth Ratio:	12.93	
Rosgen Stream Classification:	C 4b	

RIVERMORPH PARTICLE SUMMARY

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: bar sample
Survey Date: 09/04/2003

SIEVE (mm)	NET WT
75	1220.32
37.5	2813.53
25	1984.62
16	1579.9
9.5	1680.83
4.75	1914.08
2	1894.44
0.425	2222.12
0.15	1153.41
0.075	728.16
PAN	136.49

D16 (mm)	0.96
D35 (mm)	4.65
D50 (mm)	11.88
D84 (mm)	54.31
D95 (mm)	77.03
D100 (mm)	93
Silt/Clay (%)	0
Sand (%)	24.47
Gravel (%)	64.77
Cobble (%)	10.76
Boulder (%)	0
Bedrock (%)	0

Total Weight = 17327.9000.

Largest Surface Particles:

	Size(mm)	Weight
Particle 1:	82	
Particle 2:	93	

RIVERMORPH PARTICLE SUMMARY

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: reach average
Survey Date: 09/04/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	12	11.21	11.21
0.062 - 0.125	2	1.87	13.08
0.125 - 0.25	3	2.80	15.89
0.25 - 0.50	0	0.00	15.89
0.50 - 1.0	1	0.93	16.82
1.0 - 2.0	0	0.00	16.82
2.0 - 4.0	3	2.80	19.63
4.0 - 5.7	5	4.67	24.30
5.7 - 8.0	4	3.74	28.04
8.0 - 11.3	7	6.54	34.58
11.3 - 16.0	5	4.67	39.25
16.0 - 22.6	7	6.54	45.79
22.6 - 32.0	10	9.35	55.14
32 - 45	14	13.08	68.22
45 - 64	10	9.35	77.57
64 - 90	12	11.21	88.79
90 - 128	7	6.54	95.33
128 - 180	4	3.74	99.07
180 - 256	1	0.93	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.56
D35 (mm)	11.72
D50 (mm)	26.83
D84 (mm)	78.9
D95 (mm)	126.08
D100 (mm)	255.99
Silt/Clay (%)	11.21
Sand (%)	5.61
Gravel (%)	60.75
Cobble (%)	22.43
Boulder (%)	0
Bedrock (%)	0

Total Particles = 107.

RIVERMORPH PARTICLE SUMMARY

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: xs 4 riffle
Survey Date: 09/04/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	2.73	2.73
0.062 - 0.125	0	0.00	2.73
0.125 - 0.25	2	1.82	4.55
0.25 - 0.50	2	1.82	6.36
0.50 - 1.0	4	3.64	10.00
1.0 - 2.0	1	0.91	10.91
2.0 - 4.0	4	3.64	14.55
4.0 - 5.7	6	5.45	20.00
5.7 - 8.0	6	5.45	25.45
8.0 - 11.3	3	2.73	28.18
11.3 - 16.0	7	6.36	34.55
16.0 - 22.6	6	5.45	40.00
22.6 - 32.0	11	10.00	50.00
32 - 45	15	13.64	63.64
45 - 64	11	10.00	73.64
64 - 90	13	11.82	85.45
90 - 128	10	9.09	94.55
128 - 180	6	5.45	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	4.45
D35 (mm)	16.54
D50 (mm)	32
D84 (mm)	86.81
D95 (mm)	132.29
D100 (mm)	180
Silt/Clay (%)	2.73
Sand (%)	8.18
Gravel (%)	62.73
Cobble (%)	26.36
Boulder (%)	0
Bedrock (%)	0

Total Particles = 110.

RIVERMORPH PARTICLE SUMMARY

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: xs 3 pool
Survey Date: 09/04/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	3.70	3.70
0.062 - 0.125	2	1.85	5.56
0.125 - 0.25	1	0.93	6.48
0.25 - 0.50	2	1.85	8.33
0.50 - 1.0	1	0.93	9.26
1.0 - 2.0	4	3.70	12.96
2.0 - 4.0	4	3.70	16.67
4.0 - 5.7	5	4.63	21.30
5.7 - 8.0	9	8.33	29.63
8.0 - 11.3	12	11.11	40.74
11.3 - 16.0	6	5.56	46.30
16.0 - 22.6	8	7.41	53.70
22.6 - 32.0	14	12.96	66.67
32 - 45	11	10.19	76.85
45 - 64	11	10.19	87.04
64 - 90	7	6.48	93.52
90 - 128	2	1.85	95.37
128 - 180	1	0.93	96.30
180 - 256	1	0.93	97.22
256 - 362	2	1.85	99.07
362 - 512	1	0.93	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	3.64
D35 (mm)	9.6
D50 (mm)	19.3
D84 (mm)	58.33
D95 (mm)	120.4
D100 (mm)	511.98
Silt/Clay (%)	3.7
Sand (%)	9.26
Gravel (%)	74.08
Cobble (%)	10.18
Boulder (%)	2.78
Bedrock (%)	0

Total Particles = 108.

RIVERMORPH PARTICLE SUMMARY

River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: xs 2 riffle
Survey Date: 09/04/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	1	1.03	1.03
0.25 - 0.50	0	0.00	1.03
0.50 - 1.0	1	1.03	2.06
1.0 - 2.0	3	3.09	5.15
2.0 - 4.0	2	2.06	7.22
4.0 - 5.7	5	5.15	12.37
5.7 - 8.0	8	8.25	20.62
8.0 - 11.3	6	6.19	26.80
11.3 - 16.0	14	14.43	41.24
16.0 - 22.6	15	15.46	56.70
22.6 - 32.0	16	16.49	73.20
32 - 45	17	17.53	90.72
45 - 64	6	6.19	96.91
64 - 90	3	3.09	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	6.71
D35 (mm)	13.97
D50 (mm)	19.74
D84 (mm)	40.01
D95 (mm)	58.14
D100 (mm)	90
Silt/Clay (%)	0
Sand (%)	5.15
Gravel (%)	91.76
Cobble (%)	3.09
Boulder (%)	0
Bedrock (%)	0

Total Particles = 97.

RIVERMORPH PARTICLE SUMMARY

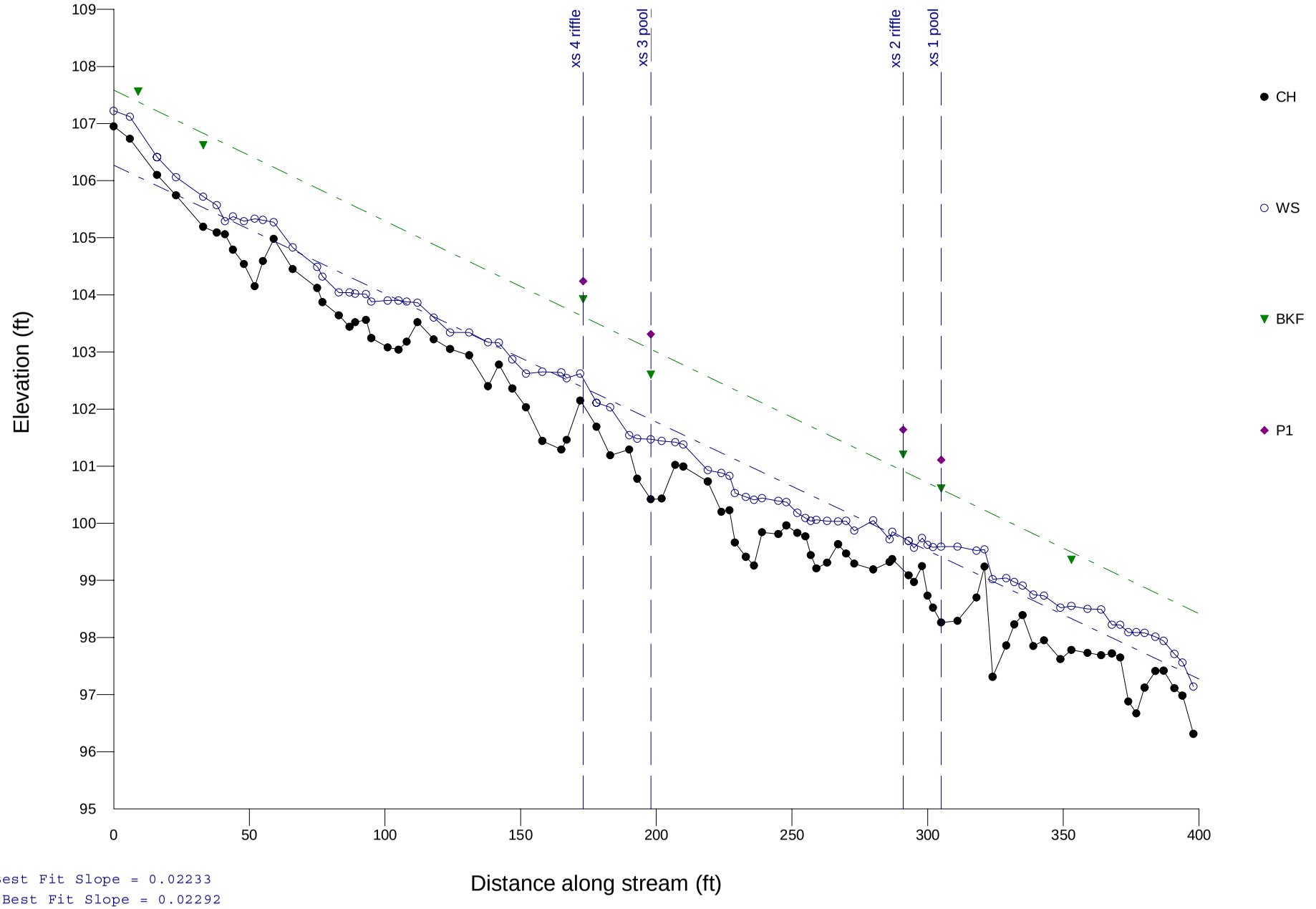
River Name: Lower Brier Creek (C4b)
Reach Name: Reach 1
Sample Name: xs 1 pool
Survey Date: 09/04/2003

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	10	9.52	9.52
0.062 - 0.125	0	0.00	9.52
0.125 - 0.25	1	0.95	10.48
0.25 - 0.50	0	0.00	10.48
0.50 - 1.0	1	0.95	11.43
1.0 - 2.0	0	0.00	11.43
2.0 - 4.0	5	4.76	16.19
4.0 - 5.7	3	2.86	19.05
5.7 - 8.0	5	4.76	23.81
8.0 - 11.3	8	7.62	31.43
11.3 - 16.0	14	13.33	44.76
16.0 - 22.6	9	8.57	53.33
22.6 - 32.0	8	7.62	60.95
32 - 45	14	13.33	74.29
45 - 64	9	8.57	82.86
64 - 90	11	10.48	93.33
90 - 128	3	2.86	96.19
128 - 180	1	0.95	97.14
180 - 256	1	0.95	98.10
256 - 362	0	0.00	98.10
362 - 512	2	1.90	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

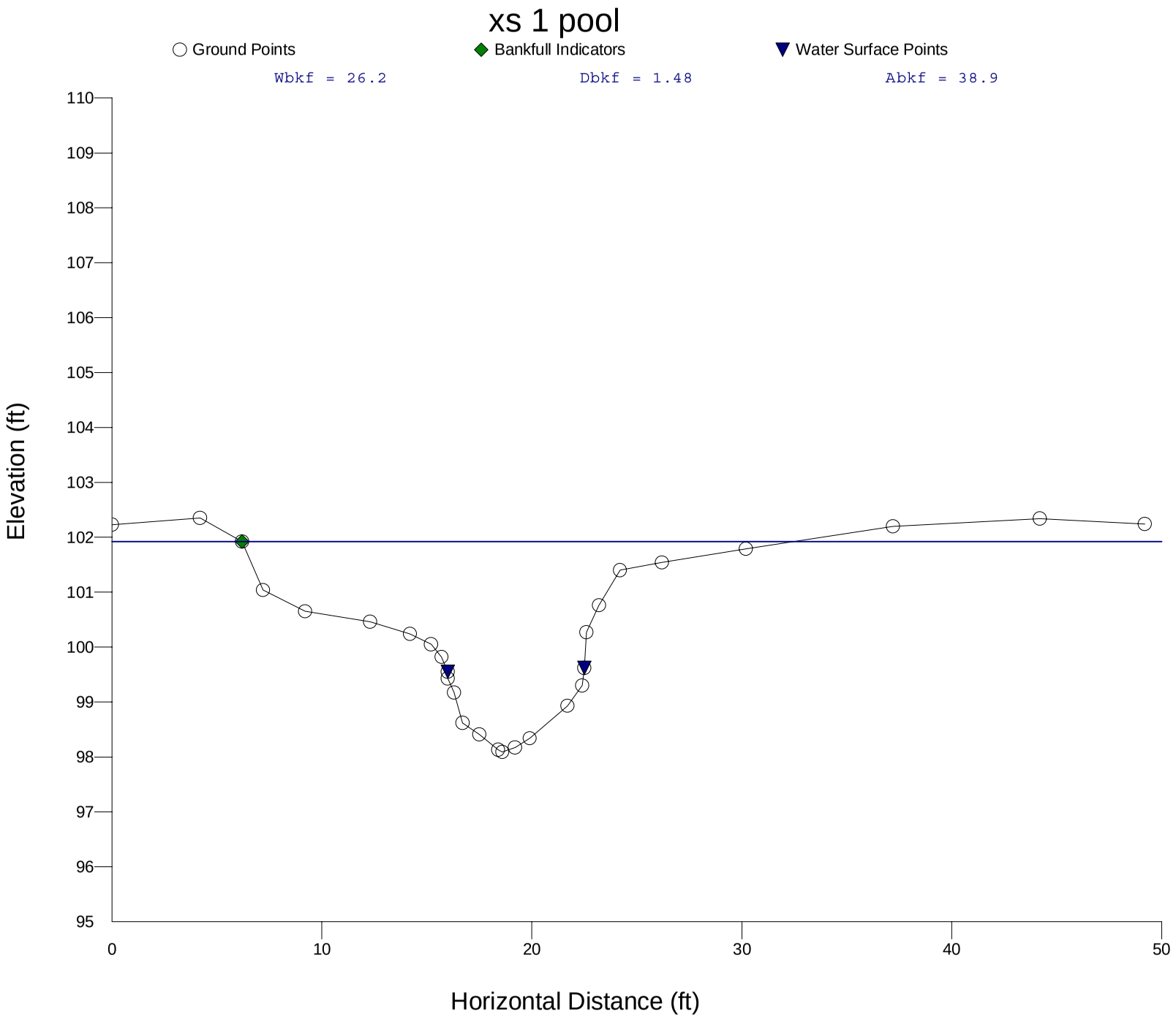
D16 (mm)	3.92
D35 (mm)	12.56
D50 (mm)	20.04
D84 (mm)	66.83
D95 (mm)	112.19
D100 (mm)	511.99
Silt/Clay (%)	9.52
Sand (%)	1.91
Gravel (%)	71.43
Cobble (%)	15.24
Boulder (%)	1.9
Bedrock (%)	0

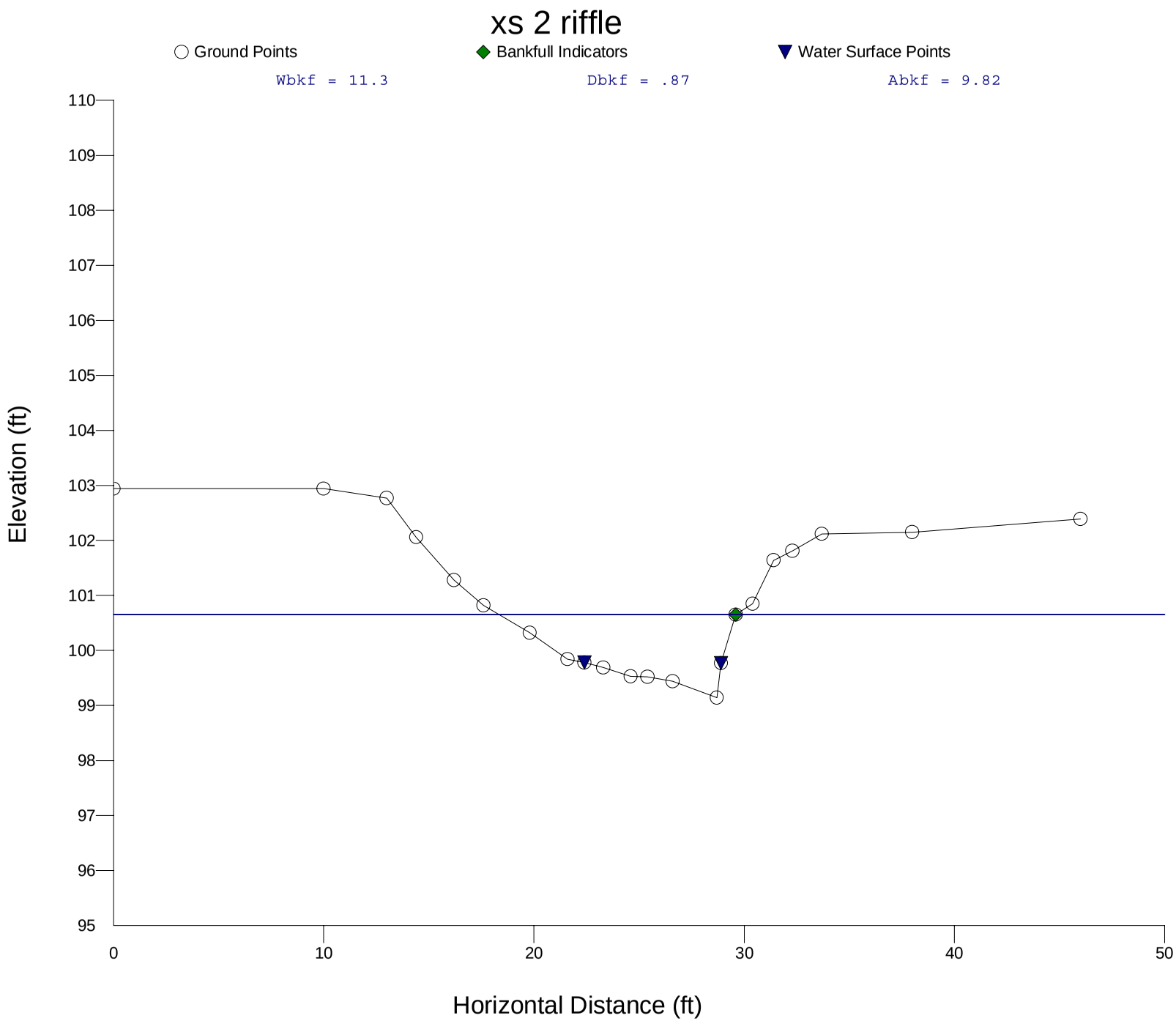
Total Particles = 105.

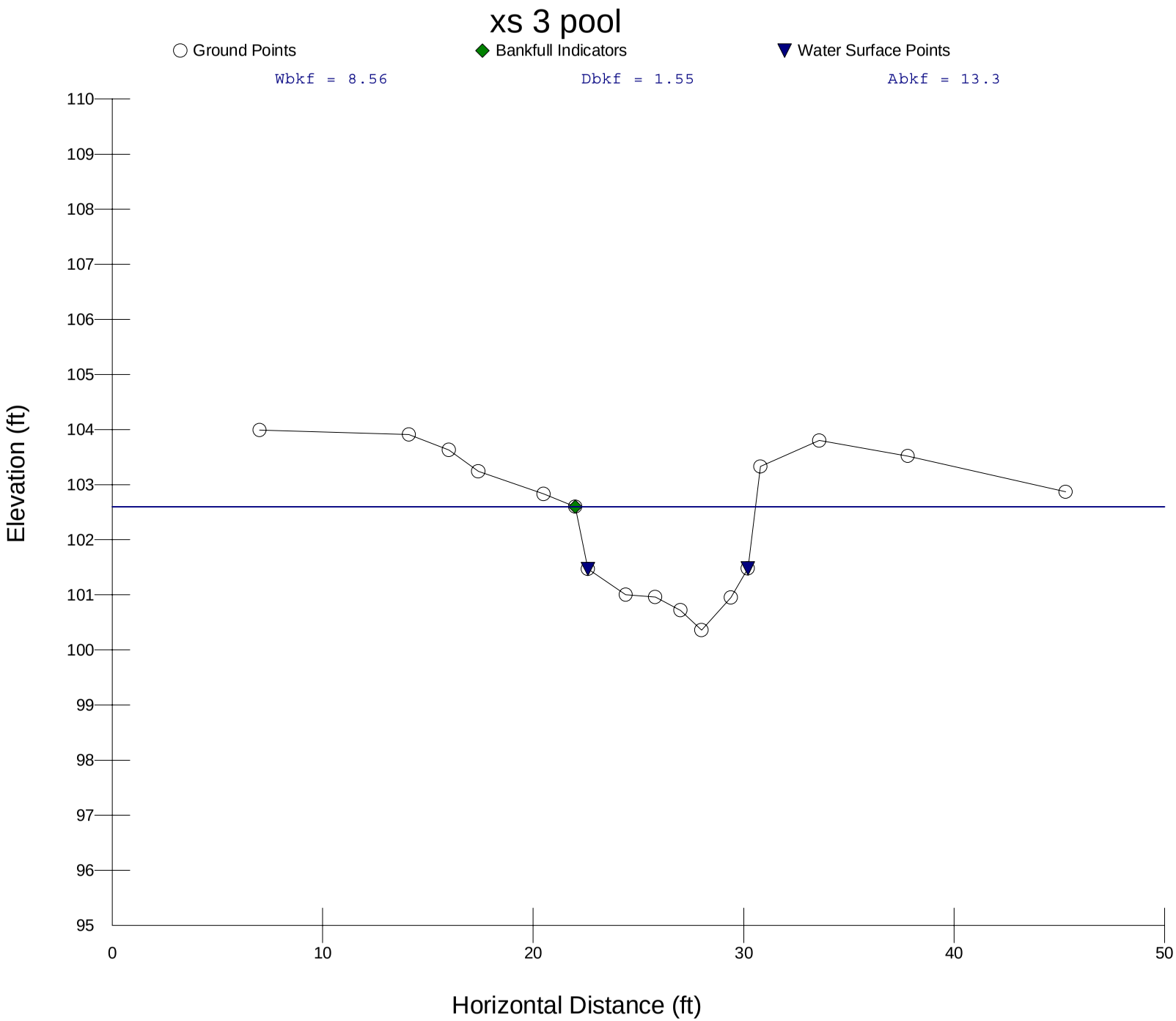
Lower Brier Creek Profile

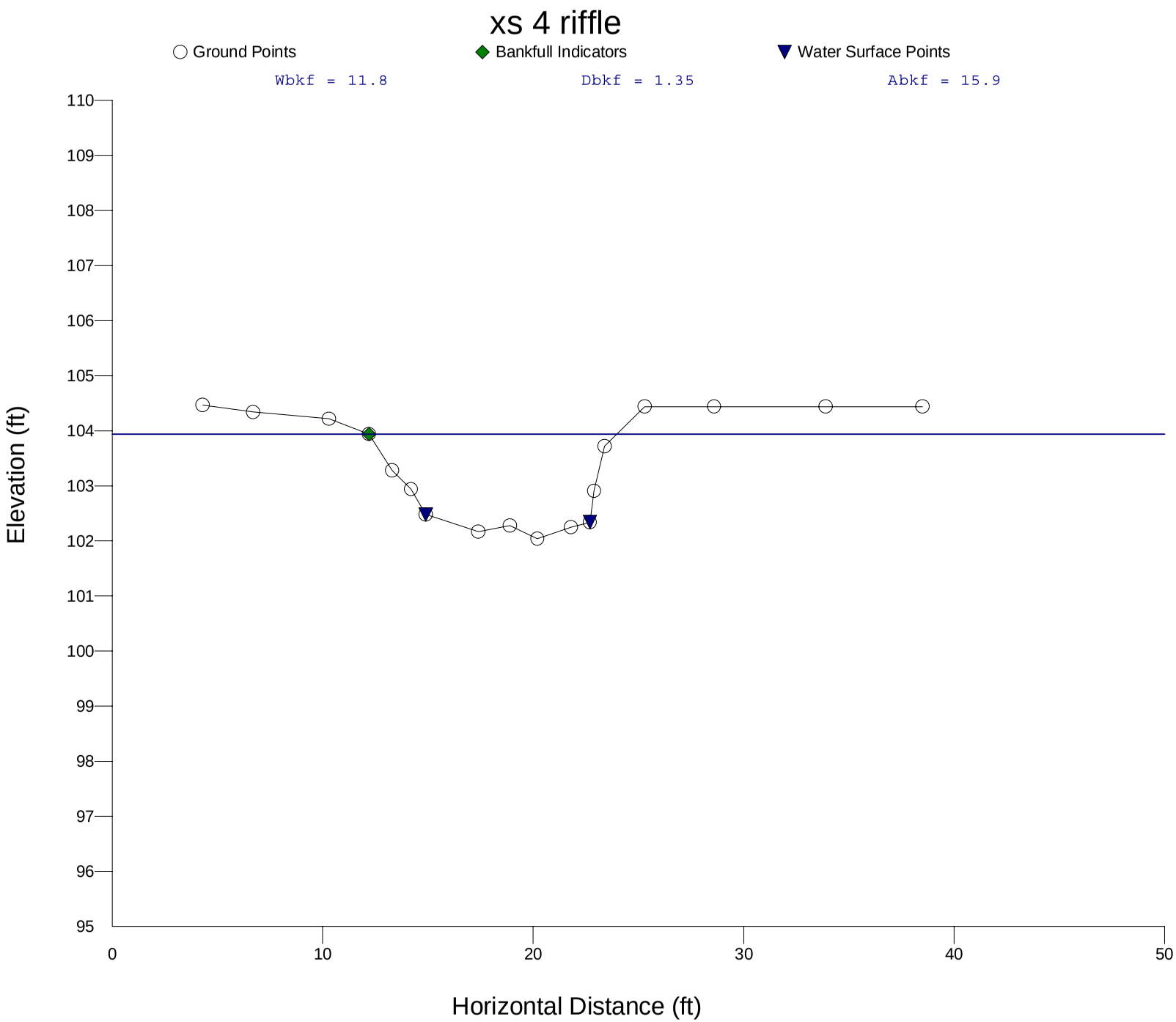


WS Best Fit Slope = 0.02233
BKF Best Fit Slope = 0.02292


xs 1 pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 26.2
Dbkf = 1.48
Abkf = 38.9
Elevation (ft)
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
0
10
20
30
40
50
Horizontal Distance (ft)


xs 2 riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 11.3
Dbkf = .87
Abkf = 9.82
Elevation (ft)
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
0
10
20
30
40
50
Horizontal Distance (ft)


xs 3 pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.56
Dbkf = 1.55
Abkf = 13.3
Elevation (ft)
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
0
10
20
30
40
50
Horizontal Distance (ft)


xs 4 riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 11.8
Dbkf = 1.35
Abkf = 15.9
Elevation (ft)
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
0
10
20
30
40
50
Horizontal Distance (ft)

Appendix E – Credits Table

Mitigation Credit and Value Table
East Fork Little Sandy Stream Restoration Project
Lawrence County, Kentucky

STREAM CREDIT

			Before Impact									After Impact							
Reach	Flow Regime	Type of Impact	Conductivity	Initial RBP Score	Habitat Integrity Index	Conductivity Index	EII	Initial Quality	Impact Length (feet)	Ratio	Debit (ft)	Predicted RPB score	Predicted Quality	Habitat Integrity Index	Predicted EII	Predicted Ratio	Final Length (ft)	Credits (ft)	Balance (Credit - Debit) (ft)
EFLS	Perennial	Natural Channel Design	203	97	0.10	0.85	0.47	Poor	5000	2.19	10969	162	Excellent	0.87	0.86	2.79	4950	13811	2,842
LEF R1	Perennial	Natural Channel Design	203	81	0.10	0.85	0.47	Poor	1627	2.19	3569	162	Excellent	0.87	0.86	2.79	1644	4587	1,018
LEF R2	Perennial	Stream Enhancement	203	79	0.10	0.85	0.47	Poor	1491	2.19	3271	140	Average	0.50	0.67	2.51	1496	3747	477
LEF Trib	Intermittent	Natural Channel Design	203	65	0.10	0.85	0.55	Poor	280	1.55	434	160	Excellent	0.83	0.92	1.92	275	528	94
Trib 1 R1	Intermittent	Natural Channel Design	203	108	0.18	0.85	0.51	Poor	590	1.51	891	163	Excellent	0.88	0.87	1.87	592	1107	216
Trib 1 R2	Intermittent	Natural Channel Design	203	115	0.25	0.85	0.55	Poor	1770	1.55	2744	164	Excellent	0.90	0.87	1.87	1725	3226	482
Trib 1 R3	Intermittent	Natural Channel Design	203	94	0.10	0.85	0.47	Poor	661	1.46	967	162	Excellent	0.87	0.86	1.86	661	1229	263
Trib 1A	Ephemeral	Natural Channel Design	203	99	0.10	0.85	0.47	Poor	371	0.73	271	144	Average	0.57	0.71	0.86	379	324	53
Trib2 R1	Ephemeral	Stream Enhancement	203	94	0.10	0.85	0.47	Poor	644	0.73	471	147	Average	0.62	0.73	0.87	644	557	86
Trib2 R2	Intermittent	Stream Enhancement	203	96	0.10	0.85	0.47	Poor	310	1.46	453	163	Excellent	0.88	0.87	1.87	310	580	126

Total Net Stream Credits **5,656**

Appendix F – NCD Data

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: EF Little Sandy River
Reach Name: Reach 1

--Reference Reach--

EF Little Sandy River; Restored Reach (B 5c)

--Boundary Conditions--

Drainage Area:	7 sq mi
Valley Slope:	0.0022 ft/ft
Bankfull Discharge:	205 cfs
Bankfull Cross Sectional Area:	48.36 sq ft
Mean Depth Calculation Tolerance:	0.1 ft

--Sediment Data--

Riffle Bed Material ID:	
Riffle Bed Material D84:	12.87 mm
Riffle Bed Material D50:	5.61 mm
Bar Sample ID:	
Bar Sample Dmax:	32.09 mm
Bar Sample D50:	0.86 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	294.12 ft
Channel Length:	352.94 ft
Sinuosity:	1.2
Radius of Curvature:	66.42 ft
Bankfull Slope:	0.00183
Meander Belt Width:	94.57 ft
Meander Width Ratio:	3
Deflection Angle:	.9 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	20.51
Entrenchment Ratio:	1.9
Floodprone Width:	59.83 ft
Bankfull Width:	31.49 ft
Bankfull Mean Depth:	1.54 ft
Bankfull Velocity:	4.24 ft/s
Bankfull Hydraulic Radius:	1.4 ft
Bankfull Shear Stress:	0.16 lbs/sq ft
Required Roughness (n):	0.0188 ft^(1/6)
Entrainable Particle Size:	9.6 mm

--Rosgen Stream Classification--

Reference Reach :	B 5c

Proposed Reach :	B 5c	
Existing Reach :	E 5	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	0.2	
Ratio - D50bed / D50bar:	6.523	
Critical Dimensionless Shear Stress (1):	0.0163	
Required Mean Depth (1):	1.54	ft
Ratio - Di bar / D50bed:	5.720	
Critical Dimensionless Shear Stress (2):	0.0082	
Required Mean Depth (2):	0.78	ft

Minimum Required Mean Depth: 1.54 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Little East Fork
Reach Name: Reach 1

--Reference Reach--

Hyatts Fork (C4); Hyatts Fork RR (C 4)

--Boundary Conditions--

Drainage Area:	1.9 sq mi
Valley Slope:	0.0024 ft/ft
Bankfull Discharge:	67 cfs
Bankfull Cross Sectional Area:	19 sq ft
Mean Depth Calculation Tolerance:	0.1 ft

--Sediment Data--

Riffle Bed Material ID:	
Riffle Bed Material D84:	43.42 mm
Riffle Bed Material D50:	23.12 mm
Bar Sample ID:	
Bar Sample Dmax:	24.19 mm
Bar Sample D50:	3.42 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	175.7 ft
Channel Length:	209.08 ft
Sinuosity:	1.19
Radius of Curvature:	40.22 ft
Bankfull Slope:	0.00202
Meander Belt Width:	54.97 ft
Meander Width Ratio:	3.03
Deflection Angle:	.88 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	17.34
Entrenchment Ratio:	8.03
Floodprone Width:	145.74 ft
Bankfull Width:	18.15 ft
Bankfull Mean Depth:	1.05 ft
Bankfull Velocity:	3.53 ft/s
Bankfull Hydraulic Radius:	0.94 ft
Bankfull Shear Stress:	0.118 lbs/sq ft
Required Roughness (n):	0.0182 ft^(1/6)
Entrainable Particle Size:	7.6 mm

--Rosgen Stream Classification--

Reference Reach :	C 4

Proposed Reach :	C 4	
Existing Reach :	C 4	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	1.91	
Ratio - D50bed / D50bar:	6.760	
Critical Dimensionless Shear Stress (1):	0.0158	
Required Mean Depth (1):	1.02	ft
Ratio - Di bar / D50bed:	1.046	
Critical Dimensionless Shear Stress (2):	0.0369	
Required Mean Depth (2):	2.39	ft

Minimum Required Mean Depth: 1.02 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Trib-1
Reach Name: Reach 1

--Reference Reach--

Flagg Spring Creek; No 2 (B4c) (B 4c)

--Boundary Conditions--

Drainage Area:	0.152 sq mi
Valley Slope:	0.024 ft/ft
Bankfull Discharge:	12.59 cfs
Bankfull Cross Sectional Area:	3.17 sq ft
Mean Depth Calculation Tolerance:	0.05 ft

--Sediment Data--

Riffle Bed Material ID:	XS-2
Riffle Bed Material D84:	38.5 mm
Riffle Bed Material D50:	17.2 mm
Bar Sample ID:	Bar Sample
Bar Sample Dmax:	51 mm
Bar Sample D50:	7.16 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	68 ft
Channel Length:	73.44 ft
Sinuosity:	1.08
Radius of Curvature:	20.44 ft
Bankfull Slope:	0.02215
Meander Belt Width:	14.03 ft
Meander Width Ratio:	2.15
Deflection Angle:	.61 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	13.38
Entrenchment Ratio:	2.03
Floodprone Width:	13.22 ft
Bankfull Width:	6.51 ft
Bankfull Mean Depth:	0.49 ft
Bankfull Velocity:	3.97 ft/s
Bankfull Hydraulic Radius:	0.42 ft
Bankfull Shear Stress:	0.581 lbs/sq ft
Required Roughness (n):	0.0312 ft^(1/6)
Entrainable Particle Size:	34.6 mm

--Rosgen Stream Classification--

Reference Reach :	B 4c

Proposed Reach : B 4
Existing Reach : B4

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope: 2.82

Ratio - D50bed / D50bar: 2.402
Critical Dimensionless Shear Stress (1): 0.0388
Required Mean Depth (1): 0.48 ft
Ratio - Di bar / D50bed: 2.965
Critical Dimensionless Shear Stress (2): 0.0146
Required Mean Depth (2): 0.18 ft

Minimum Required Mean Depth: 0.48 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Trib-1
Reach Name: Reach 2

--Reference Reach--

Flagg Spring Creek; No 2 (B4c) (B 4c)

--Boundary Conditions--

Drainage Area:	0.219	sq mi
Valley Slope:	0.0085	ft/ft
Bankfull Discharge:	17.25	cfs
Bankfull Cross Sectional Area:	4.77	sq ft
Mean Depth Calculation Tolerance:	0.05	ft

--Sediment Data--

Riffle Bed Material ID:		
Riffle Bed Material D84:	38.5	mm
Riffle Bed Material D50:	17.2	mm
Bar Sample ID:		
Bar Sample Dmax:	51	mm
Bar Sample D50:	7.16	mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	83.5	ft
Channel Length:	95.19	ft
Sinuosity:	1.14	
Radius of Curvature:	20.91	ft
Bankfull Slope:	0.00746	
Meander Belt Width:	22.32	ft
Meander Width Ratio:	2.63	
Deflection Angle:	.77	rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	15.1	
Entrenchment Ratio:	2.03	
Floodprone Width:	17.23	ft
Bankfull Width:	8.49	ft
Bankfull Mean Depth:	0.56	ft
Bankfull Velocity:	3.62	ft/s
Bankfull Hydraulic Radius:	0.5	ft
Bankfull Shear Stress:	0.233	lbs/sq ft
Required Roughness (n):	0.0224	ft^(1/6)
Entrainable Particle Size:	13.1	mm

--Rosgen Stream Classification--

Reference Reach :	B 4c	

Proposed Reach :	B 4c	
Existing Reach :	B 4c	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	2.82	
Ratio - D50bed / D50bar:	2.402	
Critical Dimensionless Shear Stress (1):	0.0388	
Required Mean Depth (1):	1.44	ft
Ratio - Di bar / D50bed:	2.965	
Critical Dimensionless Shear Stress (2):	0.0146	
Required Mean Depth (2):	0.54	ft

Minimum Required Mean Depth: 0.54 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Trib-1
Reach Name: Reach 3

--Reference Reach--

Hyatts Fork (C4); Hyatts Fork RR (C 4)

--Boundary Conditions--

Drainage Area:	0.3 sq mi
Valley Slope:	0.004 ft/ft
Bankfull Discharge:	24.25 cfs
Bankfull Cross Sectional Area:	6 sq ft
Mean Depth Calculation Tolerance:	0.05 ft

--Sediment Data--

Riffle Bed Material ID:	
Riffle Bed Material D84:	12.89 mm
Riffle Bed Material D50:	7.21 mm
Bar Sample ID:	
Bar Sample Dmax:	51 mm
Bar Sample D50:	7.16 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	112.4 ft
Channel Length:	129.26 ft
Sinuosity:	1.15
Radius of Curvature:	27.4 ft
Bankfull Slope:	0.00347
Meander Belt Width:	31.41 ft
Meander Width Ratio:	3.08
Deflection Angle:	.8 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	17.34
Entrenchment Ratio:	8.03
Floodprone Width:	81.91 ft
Bankfull Width:	10.2 ft
Bankfull Mean Depth:	0.59 ft
Bankfull Velocity:	4.04 ft/s
Bankfull Hydraulic Radius:	0.53 ft
Bankfull Shear Stress:	0.115 lbs/sq ft
Required Roughness (n):	0.0142 ft^(1/6)
Entrainable Particle Size:	7.5 mm

--Rosgen Stream Classification--

Reference Reach :	C 4

Proposed Reach :	C 4	
Existing Reach :	E 4	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	1.91	
Ratio - D50bed / D50bar:	1.007	
Critical Dimensionless Shear Stress (1):	0.0829	
Required Mean Depth (1):	6.60	ft
Ratio - Di bar / D50bed:	7.074	
Critical Dimensionless Shear Stress (2):	0.0068	
Required Mean Depth (2):	0.54	ft

Minimum Required Mean Depth: 0.54 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Trib-2
Reach Name: Reach 2

--Reference Reach--

Lower Brier Creek (C4b); Reach 1 (C 4b)

--Boundary Conditions--

Drainage Area:	0.025	sq mi
Valley Slope:	0.0242	ft/ft
Bankfull Discharge:	13.2	cfs
Bankfull Cross Sectional Area:	3.26	sq ft
Mean Depth Calculation Tolerance:	0.05	ft

--Sediment Data--

Riffle Bed Material ID:		
Riffle Bed Material D84:	38.5	mm
Riffle Bed Material D50:	17.2	mm
Bar Sample ID:		
Bar Sample Dmax:	51	mm
Bar Sample D50:	7.16	mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	54.54	ft
Channel Length:	61.63	ft
Sinuosity:	1.13	
Radius of Curvature:	13.91	ft
Bankfull Slope:	0.02138	
Meander Belt Width:	14.17	ft
Meander Width Ratio:	2.18	
Deflection Angle:	.75	rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	12.93	
Entrenchment Ratio:	17.78	
Floodprone Width:	115.39	ft
Bankfull Width:	6.49	ft
Bankfull Mean Depth:	0.5	ft
Bankfull Velocity:	4.05	ft/s
Bankfull Hydraulic Radius:	0.43	ft
Bankfull Shear Stress:	0.574	lbs/sq ft
Required Roughness (n):	0.0306	ft^(1/6)
Entrainable Particle Size:	34.1	mm

--Rosgen Stream Classification--

Reference Reach :	C 4b

Proposed Reach :	C 4b	
Existing Reach :	E 4b	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	2.27	
Ratio - D50bed / D50bar:	2.402	
Critical Dimensionless Shear Stress (1):	0.0388	
Required Mean Depth (1):	0.50	ft
Ratio - Di bar / D50bed:	2.965	
Critical Dimensionless Shear Stress (2):	0.0146	
Required Mean Depth (2):	0.19	ft

Minimum Required Mean Depth: 0.50 ft

Appendix G – Design Plans

Appendix H – Success Criteria

East Fork Little Sandy Stream Restoration Success Criteria

Geomorphological Criteria for Reconstructed and Constructed Reaches*

Critieria		As-Built / Year 1			Year 2			Year 3			Year 4			Year 5		
		Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
East Fork Little Sandy River	W_{bkf} (ft)	15.8	31.5	47.3	15.8	31.5	47.3	15.8	31.5	47.3	15.8	31.5	47.3	15.8	31.5	47.3
	D_{bkf} (ft)	0.78	1.55	2.33	0.78	1.55	2.33	0.78	1.55	2.33	0.78	1.55	2.33	0.78	1.55	2.33
	A_{bkf} (ft^2)	24.3	48.5	72.8	24.3	48.5	72.8	24.3	48.5	72.8	24.3	48.5	72.8	24.3	48.5	72.8
Little East Fork Reach 1	W_{bkf} (ft)	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2
	D_{bkf} (ft)	0.47	0.93	1.40	0.47	0.93	1.40	0.47	0.93	1.40	0.47	0.93	1.40	0.47	0.93	1.40
	A_{bkf} (ft^2)	9.75	19.5	29.3	9.75	19.5	29.3	9.75	19.5	29.3	9.75	19.5	29.3	9.75	19.5	29.3
Little East Fork Reach 2	W_{bkf} (ft)	6.55	13.1	19.7	6.55	13.1	19.7	6.55	13.1	19.7	6.55	13.1	19.7	6.55	13.1	19.7
	D_{bkf} (ft)	0.69	1.38	2.07	0.69	1.38	2.07	0.69	1.38	2.07	0.69	1.38	2.07	0.69	1.38	2.07
	A_{bkf} (ft^2)	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2	9.05	18.1	27.2
Tributary 1 Reach 1	W_{bkf} (ft)	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75
	D_{bkf} (ft)	0.25	0.49	0.74	0.25	0.49	0.74	0.25	0.49	0.74	0.25	0.49	0.74	0.25	0.49	0.74
	A_{bkf} (ft^2)	1.57	3.14	4.71	1.57	3.14	4.71	1.57	3.14	4.71	1.57	3.14	4.71	1.57	3.14	4.71
Tributary 1 Reach 2	W_{bkf} (ft)	4.25	8.50	12.8	4.25	8.50	12.8	4.25	8.50	12.8	4.25	8.50	12.8	4.25	8.50	12.8
	D_{bkf} (ft)	0.28	0.56	0.84	0.28	0.56	0.84	0.28	0.56	0.84	0.28	0.56	0.84	0.28	0.56	0.84
	A_{bkf} (ft^2)	2.38	4.75	7.13	2.38	4.75	7.13	2.38	4.75	7.13	2.38	4.75	7.13	2.38	4.75	7.13
Tributary 1 Reach 3	W_{bkf} (ft)	5.10	10.2	15.3	5.10	10.2	15.3	5.10	10.2	15.3	5.10	10.2	15.3	5.10	10.2	15.3
	D_{bkf} (ft)	0.30	0.60	0.90	0.30	0.60	0.90	0.30	0.60	0.90	0.30	0.60	0.90	0.30	0.60	0.90
	A_{bkf} (ft^2)	3.03	6.05	9.08	3.03	6.05	9.08	3.03	6.05	9.08	3.03	6.05	9.08	3.03	6.05	9.08
Tributary 2 Reach 2	W_{bkf} (ft)	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75	3.25	6.50	9.75
	D_{bkf} (ft)	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75
	A_{bkf} (ft^2)	1.63	3.25	4.88	1.63	3.25	4.88	1.63	3.25	4.88	1.63	3.25	4.88	1.63	3.25	4.88
Stable banks and channel		Asssessed visually for instability. Photograph documentation bi-annually			Asssessed visually for instability. Photograph documentation bi-annually			Asssessed visually for instability. Photograph documentation bi-annually			Asssessed visually for instability. Photograph documentation bi-annually			Asssessed visually for instability. Photograph documentation bi-annually		
Habitat Criteria for Mitigation Areas																
RBP (high gradient, habitat)		Poor (0-116)			Poor (0-116)			Poor (0-116)			Average (117-159)			Excellent (160+)		
Vegetation Criteria for Planted Areas																
% Native Tree Species		75%			75%			75%			75%			80%		
Max.% Invasive Trees		20%			20%			15%			15%			10%		
Min. Total Native Stem Density per acre		325			300			300			300			300		
Maximum Percent any one tree Species		20%			20%			25%			25%			25%		
Species List (Scientific & Common Name, Wetland Status Indicator, Native vs. Non-Native vs. Invasive)		Yes			Yes			Yes			Yes			Yes		

*Measured stream features will likey vary as the vegetation establishes over the first few years. These changes occur as the channel evolves and do not indicate lack of project success/stability (i.e. Stream could naturally evolve from a C-type channel to an E-type channel).

V. Agency Correspondence

1. State Historic Preservation Officer

COMMERCE CABINET
KENTUCKY HERITAGE COUNCIL

Steven L. Beshear
Governor

The State Historic Preservation Office
300 Washington Street
Frankfort, Kentucky 40601
Phone (502) 564-7005
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Marcheta Sparrow
Secretary

November 6, 2008

Ms. Wanda Lawson
Project Engineer
Stantec Consulting Services, Inc.
1901 Nelson Miller Parkway
Louisville, Kentucky 40223-2177

Re: Stream Restoration and Enhancement Project
East Fork Little Sandy River and Tributaries
Lawrence County, Kentucky

Dear Ms. Lawson:

Thank you for your letter of October 13, 2008 (received October 14, 2008) concerning the above referenced project. A review of our files indicates that there are several previously recorded archaeological sites (15La98-100) within and immediately adjacent to the project area. The proposed project area has not been investigated by a professional archaeologist to determine if additional properties eligible for listing in the National Register of Historic Places are present. Investigations of projects in similar environmental contexts have resulted in the identification of a large number of sites, some of which have been determined eligible for listing in the National Register. Given the presence of known sites within and adjacent to the project area and the environmental setting, in my opinion, the project has a high potential for impacting archaeological sites. Therefore, I recommend that all undisturbed portions of the proposed permit area be surveyed by a professional archaeologist. Further, archaeological site 15La100, which appears to be within the project boundaries, should be revisited and its current condition evaluated. A report documenting the results of this investigation must be submitted to the State Historic Preservation Officer for review, comment, and approval.

Further, in order to make a preliminary determination if above-ground properties eligible for listing in the National Register of Historic Places will be affected by this project, the applicant must submit photographs of all structures 50 years or older that are within and adjacent to the project area. Each photograph should be labeled by street address with a brief description of potential impacts or proposed treatment, and should be accompanied by a project map showing their location. Upon completion of our review, this office will advise the applicant if further consultation is required. Should you have any questions, feel free to contact Kary Stackelbeck of my staff at 564-7005, ext. 147.

Sincerely,

Mark Dennen,
Acting Executive Director and
State Historic Preservation Officer

MD:kls

2. Department of the Interior

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

December 1, 2008

Mr. Mike Hardin
Kentucky Department of Fish and Wildlife Resources
#1 Sportsman's Lane
Frankfort, KY 40601

Subject: FWS #2009-B-0025, Biological Assessment, East Fork of the Little Sandy River Stream Restoration and Enhancement Project

Dear Mr. Hardin:

We received your letter dated October 31, 2008 and the enclosed Biological Assessment (BA) prepared for the proposed East Fork Little Sandy Stream Restoration Project. This project involves three phases of restoration and enhancement totaling approximately 25,112 linear feet of stream on the East Fork of the Little Sandy River and its associated tributaries.

We have reviewed the submitted BA for the Indiana bat (*Myotis sodalis*). This BA states that there is a lack of potential winter/swarming habitat within the action area and that direct impacts to summer habitat will be avoided by removing trees only during the period when Indiana bats are expected to be absent from the area (October 15 through March 31). Additionally, the project site is 21 miles from the nearest known Indiana bat hibernacula and 23 miles from the nearest designated critical habitat (Bat Cave, Carter County). Best management practices will be employed during construction to minimize any sediment impacts associated with the stream construction of the restoration projects.

Based on the submitted information, we concur with the not likely to adversely affect determination for the Indiana bat and with the no effect finding on critical habitat (i.e., no adverse modification) for the Indiana bat. Based on these determinations and our concurrences with them, we believe that the requirements of section 7 have been fulfilled as it relates to federally listed species listed in the BA. Obligations under section 7 must be reconsidered, however, if: (1) new information reveals that the proposed project may affect listed species or proposed critical habitat in a manner or to an extent not previously considered, (2) the proposed project is subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed project.

If you need additional assistance in determining if a proposed project may impact a federally listed species, we recommend that you contact us for further assistance. Thank you for the opportunity to comment on this proposed action. If you have any questions regarding the information we have provided, please contact Jennifer Garland at (502) 695-0468 extension 115.

Sincerely,

Virgil Lee Andrews, Jr.
Field Supervisor